AD-A137 671 USER'S MANUAL FOR SAC-2 A TWO-DIMENSIONAL NONLINEAR TIME DEPENDENT SOIL A..(U) CALIFORNIA UNIV DAVIS L R HERRMANN ET AL. DEC 83 NCEL-CR-84.008 1/1

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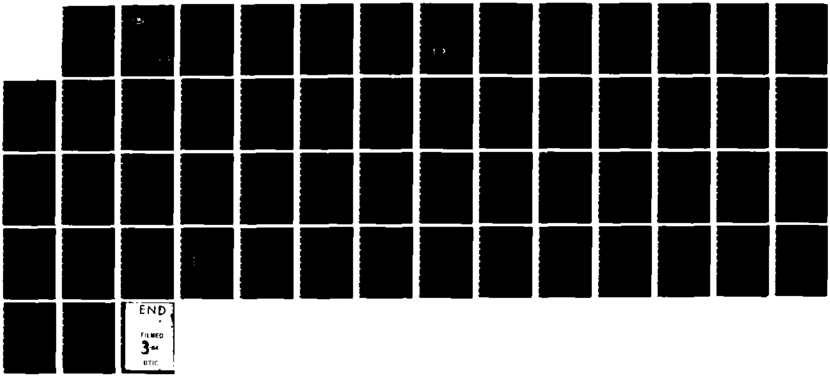

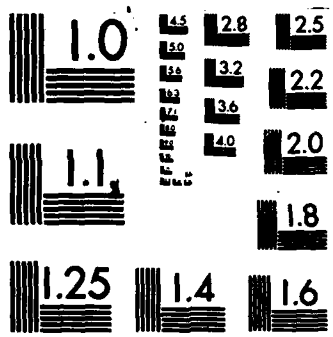

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CR 84.008

NAVAL CIVIL ENGINEERING LABORATORY
Port Hueneme, California

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AD A137671

USER'S MANUAL FOR SAC-2: A TWO-DIMENSIONAL NONLINEAR, TIME DEPENDENT SOIL ANALYSIS CODE USING THE BOUNDING SURFACE PLASTICITY MODEL

December 1983

An Investigation Conducted by
UNIVERSITY OF CALIFORNIA, DAVIS

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METRIC CONVERSION FACTORS

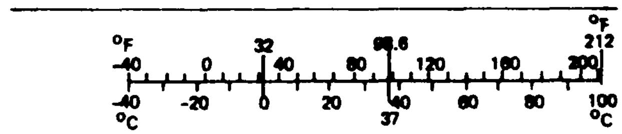
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Finite element, computer program, geotechnical engineering, soil constitutive law

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The equations governing the consolidation, and the stress and strains states for soil structures are reviewed and their historical development is discussed. Numerical analysis concepts are used to express these equations in incremental form. A variational statement of these incremental equations is formulated and used in the development of a comprehensive

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finite element analysis. The concepts used in developing the variational statement are somewhat different from those used by most other investigators and appear to offer certain advantages for inelastic formulations. Finally results obtained with the finite element analysis are compared to known solutions with good results.

For the convenience of the reader the total report on the project is presented in four parts. As noted above a description of the consolidation theory and certain theoretical features of the finite element analysis are described in the body of the main report (CR 84.006). The second part (CR 84.007) describes the numerical evaluation of the incremental form of the bounding surface model. Finally "user's manuals" for the 2-D and 3-D finite element programs are given in two additional reports (CR 84.008 and CR 84.009).

TABLE OF CONTENTS

I. INTRODUCTION

The finite element code may be used to analyze plane strain and axisymmetric, quasi-static, soil problems, including consolidation effects. The soil may be modeled using either linear elasticity or the "bounding surface plasticity model for cohesive soil". The program is written in modular form so that other soil models can be easily incorporated. The theory underlying the analysis is described fully in the accompanying report [1].

The user's manual is divided into six parts: Introduction, Input, Output, Explanatory Comments, References and Example. The Input section gives in outline form, the sequence of information required to describe the problem to be analyzed. Only the briefest notes of explanation are included in this section. Until an analyst becomes familiar with the program he or she will need to refer to the last section of the manual where detailed explanations and examples are given. The manual assumes general familiarity with finite element methods; novices in this area are referred to a standard text such as [2].

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II. INPUT

The required input data is entered by means of the following sequence of records (cards):

A1. Title Card (18A4):

Any information that is to be printed as the title of the problem.

A2. Control Card (L5, F5.0, I5, F5.0, I5, F5.0, 7I5)

Columns			
5	IQUIT	=	T(rue) - stop / F(alse) - do not stop — analysis after mesh generation
6 - 10	GRIDW	=	grid generation parameter (0.0 -"isoparametric" grid, 1.0 - "Laplacian" grid)
15	IFLOW	=	0 unsaturated problem - no water flow 1 saturated problem - water flow
16 - 20	θ_1	=	parameter controlling numerical integration in time
25	MTYPE	=	0 - plane stress analysis 1 - plane strain analysis 2 - axisymmetric analysis
26 - 30	α	=	parameter controlling "reduced" integration of volume term

Upper bounds on dimensions (used to establish dynamic storage allocation, all values except NCOFMX > 0):

31 - 35	NFUNMX	$\geq$	no. of history function specifications, Section B1
36 - 40	IFUNSZ	$\geq$	greatest no. (M) of points used to describe a given history function, Section B1
41 - 45	MATMX	$\geq$	no. of materials, Section B2
46 - 50	NCOFMX	$\geq$	no. of initial state descriptions, Section B3
51 - 55	NPTMX	$\geq$	the largest node number, Section B4
56 - 60	NELMX	$\geq$	no. of elements, Section B5
61 - 65	NDSPMX	$\geq$	no. of node point specifications, Section B6

A3. <u>Gravity Card</u> (2(E10.3, I5))

<u>Columns</u>

1 - 10 g = acceleration of gravity (magnitude)

11 - 15 IH_g = history function number for magnitude of gravity

16 - 25 θ_g = angle (in degrees) that gravity makes with negative y(z) axis

26 - 30 IH_θ = history function number for θ_g

A4. **<u>Nonlinear Analysis Card (I5, F5.0, 3I5, 2E10.3)</u>: Specification of desired iteration options** (leave blank for a nonlinear problem)

<u>Columns</u>

5 NONLIN = $\begin{cases} 0 & \text{linear problem} \\ \left.\begin{matrix} 1 \\ 2 \end{matrix}\right\} & \text{nonlinear problem-job} \begin{Bmatrix} \text{is} \\ \text{is not} \end{Bmatrix} \text{terminated if convergence does not occur} \end{cases}$

6 - 10 $0.0 \geq \beta \leq 0.5$ = parameter controlling Newton-Raphson approximation (0.0 gives the tangent stiffness method; 0.5 gives the method of successive approximation)

11 - 15 ITMAX = maximum number of iterations permitted in any single solution increment (default value = 5)

16 - 20 IRPET = $\begin{Bmatrix} 0 \\ K \end{Bmatrix}$ reform stiffness matrix every $\begin{Bmatrix} \text{iteration} \\ \text{K-th iteration} \end{Bmatrix}$ *

25 ITFAC = $\begin{Bmatrix} \text{T(rue)} \\ \text{F(alse)} \end{Bmatrix}$ variable acceleration factor applied to solution vector components

26 - 35 FL = places limits of 1/FL $\geq$ ( ) $\geq$ FL on the acceleration factor when ITFAC = T (default value = 0.3)

36 - 45 ERMAX = convergence criterion for the solution vector (default, value = 0.01)

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* after the 2nd

B1. A card with a 1 punched in column 1 followed by (if no history function specifications are required, this section is omitted entirely):

History Function Descriptions: The following cards are required for each distinct function (History functions numbered -3, -2, -1 and 0 are explicitly defined in the program, see Explanatory Notes, and thus no input is required):

1st Card (1X, I4, I5):

Columns

2 - 5	**IH**	=	function number (> 0)
6 - 10	**M**	=	number of points needed to define the function

2nd Card(s) (8E10.3):

As many cards as needed to specify the M pairs of values (F_m, t_m) which defines the function. The initial card contains the values F_1, t_1, F_2, t_2,..., F_4, t_4. Subsequent cards, if required (M > 4), contain the values F_5, t_5,..., F_M, t_M.

B2. **A card with a 2 punched in column 1, followed by:**

<u>Material Properties Array</u>: The following information must be supplied for each distinct material:

<u>1st Card (1X, I4, I5, 6E10.3):</u>

Columns			
2 - 5	NMAT	=	material number
10	ITYP	=	1 - isotropic linear-elastic 2 - anisotropic linear-elastic 3 - bounding surface plasticity model for cohesive soil
11 - 20	ρ_s	=	soil density+
21 - 30	ρ_f	=	fluid density++
31 - 40	Γ	=	bulk modulus for fluid and soil particles
41 - 50	k^*_{11}	=	effective soil permeability coefficients
51 - 60	k^*_{12}		
61 - 70	k^*_{22}		

<u>2nd Card (8E10.3):</u>

Columns	ITYP = 1	ITYP = 2	ITYP = 3
1 - 10	E	D_{11}	λ
11 - 20	ν	D_{12}	κ
21 - 30		D_{13}	M_c
31 - 40		D_{14}	R_c
41 - 50		D_{22}	A_c
51 - 60		D_{23}	T
61 - 70		D_{24}	P_l
71 - 80		D_{33}	ν or G

\+ If the acceleration of gravity (g ec.. on A3) is taken as unity then ρ_s and ρ_f are unit weights.

++ If it is desired to use "excess" not total pore water pressure then ρ_f is set equal to zero - see explanatory comments.

3rd Card (8E.10.3) - required only if ITYP > 1:

Columns	ITYP = 1	ITYP = 2	ITYP = 3
1 - 10		D_{34}	P_a
11 - 20		D_{44}	Γ (Duplicates value on "1st car
21 - 30			m
31 - 40			h_c
41 - 50			h_2
51 - 60			$n = M_e/M_c$
61 - 70			$\mu = h_e/h_c$
71 - 80			$r = R_e/R_c$

4th Card (3E10.3) - required only if ITYP = 3:

Columns	ITYP = 1	ITYP = 2	ITYP = 3
1 - 10			$a = A_e/A_c$
11 - 20			C
21 - 30			s

B3. A card with a 3 punched in column 1, followed by:

Initial State Information: The following information must be supplied for each non-trivial initial state (this section is omitted if no information is required)*

1st Card (1X, I4, 6E10.3):

Columns

2 - 5	ISNO	=	state number
6 - 15	a_1	=	initial effective, vertical stress distribution, in the form $\sigma_v = a_1 + a_2 y$
16 - 25	a_2		
26 - 35	b_1	=	initial effective, horizontal stress distribution, in the form $\sigma_h = b_1 + b_2 y$
36 - 45	b_2		
46 - 55	c_1	=	initial pore water pressure distribution, in the form $h = c_1 + c_2 y$
56 - 65	c_2		

2nd Card (4E10.3)

1 - 10	d_1	=	initial void ratio distribution, in the form $e_i = d_1 + d_2 y$
11 - 20	d_2		
21 - 30	e_1	=	initial preconsolidation pressure distribution, in the form $P_o = e_1 + e_2 y$
31 - 40	e_2		

* The initial state of $\sigma_v = \sigma_h = h = e_i = P_o = 0$, is given the number zero and is built into the program. The equations $a_1 + a_2 y$, etc. assume plane conditions. For axisymmetry, the vertical coordinate direction is z instead of y, and the distributions are then of the form $\sigma_v = a_1 + a_2 z$, etc.

B4. A card with a 4 punched in column 1, followed by:

Node Point Array (1X, I4, 2E10.3, I5, 3E10.3): As many cards as are necessary to specify the locations of all nodes in the system which are not to be generated by means of the "interior" generation scheme:

Columns				
2 - 5	N	=	node point number	
6 - 15	X	=	x(r) - coordinate	
16 - 25	Y	=	y(z) - coordinate	
26 - 30	INC	=	numbering increment	quantities associated with the straight and curved line generation options
31 - 40	D	=	spacing ratio	
41 - 50	XC	=	coordinates of some point on the interior of the circular arc	
51 - 60	YC			

B5. A card with a 5 punched in column 1, followed by:

Element Array (1X, I4, 9I5): As many cards as are necessary to specify all elements in the system:*

Columns				
2 - 5 6 - 10 11 - 15 16 - 20		=	the numbers of the four node points which describe the quadrilateral or triangular** element (reading counter-clockwise around the element)	
21 - 25	**MN**	=	material number (corresponding to the appropriate material description of section B2)	
26 - 30	**ISNO**	=	initial state number (corresponding to the appropriate initial state description of section B3)	
31 - 35	**NMISP**	=	number of additional elements in the layer	quantities associated with the element generation option
36 - 40	**INCRP**	=	numbering increment for elements within the layer	
41 - 45	**NMIS**	=	number of additional layers	
46 - 50	**INCR**	=	numbering increment for the layers	

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* The order of the element cards need bear no relation to the actual location of the elements within the body. The order will determine the assigned "element numbers."

** For a triangular element the forth node number is set equal to the first.

B6. A card with a 6 punched in column 1, followed by:

<u>Node Point Specification Array (1X, I4, 3(I3, I2, E10.3), E10.3, 2I5, 2F5.0):</u>

As many cards as are necessary to specify known nodal displacements, loads, water flows and pore water pressures.

Columns				
2 - 5	N	=	Node point number	
6 - 8	IH_1	=	history function number (Section B1) for the 1-coordinate direction	
10	IF_1	=	$\left.\begin{matrix}0\\1\end{matrix}\right\}$ indicates that a known $\left\{\begin{matrix}\text{force}\\\text{displacement}\end{matrix}\right\}$ is specified in the 1-coordinate direction	
11 - 20	V_1	=	magnitude* of the specified $\left\{\begin{matrix}\text{force}\\\text{displacement}\end{matrix}\right\}$ for the 1-coordinate direction	
21 - 23	IH_2	=	history function number (Section B1) for the 2-coordinate direction	
25	IF_2	=	$\left.\begin{matrix}0\\1\end{matrix}\right\}$ indicates that a known $\left\{\begin{matrix}\text{force}\\\text{displacement}\end{matrix}\right\}$ is specified in the 2-coordinate direction	
26 - 35	V_2	=	magnitude* of the specified $\left\{\begin{matrix}\text{force}\\\text{displacement}\end{matrix}\right\}$ for the 2-coordinate direction	
36 - 38	IH_3	=	history function number	
40	IF_3	=	$\left.\begin{matrix}0\\1\end{matrix}\right\}$ indicates that a known $\left\{\begin{matrix}\text{water flow}\\\text{pore water pressure}\end{matrix}\right\}$ is specified	
41 - 50	V_3	=	magnitude* of the specified $\left\{\begin{matrix}\text{water flow}\\\text{pore water pressure}\end{matrix}\right\}$	
51 - 60	θ_n	=	angle (in degrees) between the x_1-axis and the x(r)-axis	
61 - 65	N'	=	final node point in the sequence	quantities associated with the node point specification generation option
66 - 70	INC	=	numbering increment for node points in sequence	
71 - 75	P_N	=	values of linear varying pressures applied at points N and N' respectively**	
76 - 80	$P_{N'}$			

---

* In all cases the actual value of the prescribed quantity is the product of the "magnitude" and the value of the specified "history function"

** The history function number of P must be prescribed in IH_1 and IH_2

B7. A card with a 7 punched in column 1, followed by:

Solution History Segment Information (1X, I4, 2E10.3): One card for each history segment into which the incremental analysis is subdivided:*

Columns			
2 - 5	NMIS	=	number of solution (time) increments into which the history segment is subdivided
6 - 15	TIME	=	time at the end of the history segment
16 - 25	D	=	incrementing ratio controlling the time-step lengths within the history segment (default value = 1.0)

C. **End Card (I1):** A card with an 8 punched in column 1 to denote the end of the input data for the given problem.

The above sequence of cards A1 → C are repeated for each additional analysis in the "stack".

---

* note that the analysis begins at time $t_o = 0$

III. OUTPUT

The output from the program consists of an echo print of material properties and solution parameters, the generated node and element data, messages for detected data errors, and finally for each time step the problem solution. When data errors are detected, the program aborts the job after the printing of the input data and proceeds to the next job in the stack of data. The message "data error in element I" is triggered by a computed negative area for one or more of the four triangles formed by three successive vertices of the element. Such a negative area is a result of either an improperly shaped element resulting from a poor mesh selection, a data error in entering node point coordinates (often for one of the nodes defining the element in question) or element data (including entering the nodes CW instead of CCW - assuming the coordinate system to be right-handed).

The print out of the node point specifications includes any concentrated node point forces (in x-y components) resulting from specified surface pressures.

The printed values of strains, stresses, etc., at a given time step, are the values accumulated to that point in time including initial values. The stresses are effective stresses (tension positive). The pore water pressure (units of stress - compression positive) will be either total pressure or "excess" pressure depending on user preference, see Section B2 in part IV.

The headings for the solution output, are self explanatory with the possible exception of h which denotes the pore water pressure.

IV. EXPLANATORY NOTES REGARDING THE INPUT

General Comments:

The following comments hold for Sections B1 → B7. For example, consider Section B4. The first card in the Section contains the number 4 punched in column one; it has no other information (only one such card is used). It is followed by as many additional cards as are needed to define the node point data. The first column of each of these cards is left blank.

It is the responsibility of the user to maintain consistent units. The units used to describe gravity (Section A3), and the material properties (Section B2) must be consistent with those used to describe the initial state (Section B3), the geometry of the body (Section B4), and the node point specifications (Section B6). The solution is expressed in the same units as the input.

Because the bandwidth NBAND of the simultaneous equations is determined by the numbering of the nodes, an optimal node numbering scheme is required to minimize the computational cost of a given finite element analysis. The bandwidth resulting from a given numbering scheme is computed in the following manner:

i) Denote the span for any two nodes of a given element as N_i, where N_i is equal to the absolute difference in the node numbers.

ii) Denote the maximum value of N_i for a given element j as NE_j.

iii) Considering all elements in the system, denote the maximum value of NE_j as NE_{max}.

iv) The bandwidth is then given by the expression NBAND = (2 + IFLOW)*(NE_{max} +1)

Since NE_{max} is directly related to the bandwidth of the simultaneous equations, in numbering the nodes it is this quantity that should be minimized.

Section-by-Section Comments:

The section numbers used below correspond to the section numbers of part **II. INPUT**, thus, in order to find information concerning the input for B6 (Node Point Specification Array) the reader should refer to Section B6 below. In addition, within a given section items called out in the input are typed in bold. For example input items **β** and **ITMAX** which are required for input Section A4 are type in bold where they are discussed below in Section A4. The theory underlying the analysis is only superficially treated here; for a more complete discussion the reader is referred to [1].

A1. Title Card

The title serves to identify the particular problem under consideration.

A2. Control Card

If a T(rue) value is specified for **IQUIT** the analysis terminates after the mesh has been generated and printed. This option should be used for the first run of a large problem in order to avoid wasting computer time analyzing incorrect data. If data for several problems is contained in the stack, the program skips the time history data for the terminated job and proceeds to the next problem.

For the precise meaning of the grid generation parameter **GRIDW** the reader is referred to [3] (**GRIDW** = 1.0 - w, where w is defined in [3]). In general a value of **GRIDW** = 0.0 is recommended; for those very rare cases where this results in a singular set of equations for the grid generation process, a value of .05 is recommended.

The code **IFLOW** distinguishes between saturated conditions where water flow occurs (or a potential for water flow exists - ideal undrained conditions) and unsaturated conditions.

When **IFLOW** = 1 the soil density (or unit weight if the acceleration of gravity is taken to be unity) ρ_s specified in Section B2, refers only to the soil skeleton (unsaturated soil). The printed stresses are the "effective stresses" and must be supplemented by the pore water pressure to obtain the total stresses. If it is desired to exactly model "ideal undrained conditions" (no movement of water), the effective permeability of the soil should be set equal to zero (Section B2).

When **IFLOW** = 0 the soil density ρ_s must include the mass (or weight) of any water present in a partially saturated soil (the pore water pressure is assumed to be zero and water is assumed <u>not</u> to flow). The printed stresses are total stresses.

Conditions where part of the soil mass is unsaturated and part is saturated can be modeled by specifying for the unsaturated soil a very small bulk modulus Γ for the water (and soil particles - Section B2).

The parameter θ_1 determines the approximation used for the time derivatives in the governing equations (see [1]); values between 0.5 (Crank-Nicolson) and .67 (Galerkin) are recommended [2].

For axisymmetric analyses (**MTYPE** = 2) all x and y notations refer to r and z.

The parameter α determines the finite element approximation used for measuring volume change (see [1]). When **IFLOW** = 1, a value of 0.0 is recommended unless solution oscillation is a problem in which case a value of .1 is useful. Except for nearly incompressible linear elastic materials, when **IFLOW** = 0 a value of 1.0 is usually preferable.

All arrays in the program whose dimensions are problem dependent, are dynamically dimensioned. The values **MATMX, . . . NDSPMX** contain information for this purpose, all these quantities, with the exception of NCOFMX, must be

greater than zero. The value of MATMX, etc. are upper bounds and thus, unless it is desired to absolutely minimize storage requirements, need not be equal to the actual number of specified materials, etc. When specifying the values NELMX and NDSPMX, it must be remembered to count those elements and specifications which are included by means of the generation options.

In the dynamic dimensioning of the program, separate arrays were used for interger and floating point numbers in order to avoid difficulties for computers that use different word lengths for the two. The program has been coded so that 16 bit integers may be used if desired.

The dimensions of the program are controlled by two quantities "long" and "longi" specified in "PARAMETER" statements at the beginning of the program; these quantities must satisfy the following inequalities.

longi $\geq$ NFUNMX + NPTMX + 5*NELMX + (3+IFLOW)*NDSPMX + 1

long $\geq$ 26*MATMX + 2*NFUNMX*IFUNSZ + NCOEF*(NCOFMX + 1)

+ [2 + 4*(2 + IFLOW)]*NPTMX + (3 + IFLOW)*NDSPMX

+ LONGEQ

Where LONGEQ is the space set aside for solving the system of equations by means of a block, constant bandwidth equation solver. If the bandwidth of the equations is denoted as NBAND, then the minimum value for LONGEQ is NBAND*NBAND (only a single equation would be contained in each equation block); if it is desired to solve the equations entirely in core then it must have a value $\geq$ NBAND*(2 + IFLOW)*NPT. In general it is recommended that LONGEQ exceed the minimum by at least 30%. The calculation of the bandwidth NBAND is discussed in the general comments at the beginning of this part of the manual.

A3. Gravity Card

Gravity g can be input either in terms of the acceleration units appropriate to the system of units selected for the problem (32.2 ft/sec^2 for English units) or in terms of multiples of the acceleration of gravity at sea level (i.e. g = 1

for a field structure); the corresponding meanings of ρ_s and ρ_f (Section B3) would be mass densities in the first case and unit weights in the second. That is the product ρg must have units of weight per unit of volume.

The histories of the magnitude g and direction θ_g of gravity are specified by the history function numbers (Section B1) IH_g and IH_θ. A pre-existing gravity loading of a field deposit can be modeled by initializing the stresses and pore water pressure (Section B3) to their proper values and setting $IH_g = IH_\theta = -3$. The history of the effective gravity loading on a centrifuge model during "spin-up" can be modeled by describing in Section B1 a history function corresponding to the centrifuge velocity history for the test; in the case of a fixed bucket both g and θ_g would vary with time, while for a swing-up bucket only g would vary.

A4. Nonlinear Analyais Card

For a linear elastic problem, **NONLIN** is set equal to zero and the rest of the card is left blank. For problems using the bounding surface plasticity model, NONLIN is set equal to 1 or 2 depending on whether the analysis should be terminated or not, if convergence is not achieved in a given time step.

The factor β determines the approximation to be used for the Jacobian in the Newton-Raphson's iteration for the nonlinear problem, for details the reader is referred to [4, 5]. It is expected that a value of 0.0 will in most cases give the best results.

The frequency of updating the stiffness matrix during the iteration process is controlled by the value of **IRPET** [4]; for initial uses of the program a value of zero would appear to be appropriate. The values of **ITFAC** and **FL** control the use of acceleration factors applied to the components of the solution vector [4]; for initial use of the program it is suggested that ITFAC = F. Finally, the default value of .01 for the convergence limit **ERMAX** would appear to be adequate for most problems.

B1. History Function Descriptions

The time dependence of all input quantities (i.e., magnitude and direction of gravity, and specified node point displacements, flows, loads and pore water pressures) are specified by means of appropriate "history functions". The program has built-in four such functions numbered -3 → 0, i.e.,

i) IH = -3 Specifies a unit value and a zero incremental value for <u>all</u> times, Figure 1a.

ii) IH = -2 Specifies a zero value and a zero incremental value for <u>all</u> times - Figure 1b.

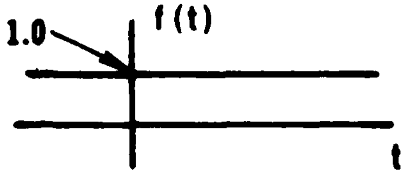
iii) IH = -1 Specifies all incremental values equal to 1.0. The incremental values are taken to be equal regardless of the relative lengths of the time steps specified in Section B7. The resulting history functions for the cases of equal and variable length time steps are illustrated in Figure 1c.

iv) IH = 0: Specifies a step-function at time t = 0; that is a quantity using this function is applied entirely during the first solution increment, Figure 1d.

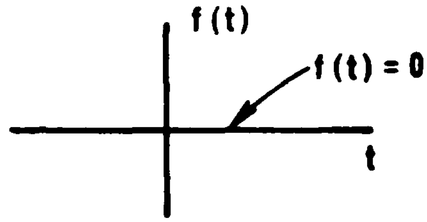
In addition, the user may described, by means of the input to Section B1, as many more history functions (numbered 1→) as needed; an example of such a function is given in Figure 2.

For a particular history function, linear interpolation is used to identify the ΔF which corresponds to a given time increment Δt. For solution times beyond the last specified point t_M, the final history segment is extended indefinitely.

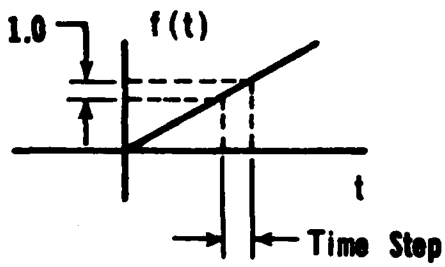
When a magnitude V and a history function number IH are specified in Section B6 (or A3) for some given external agent, then in the solution interval



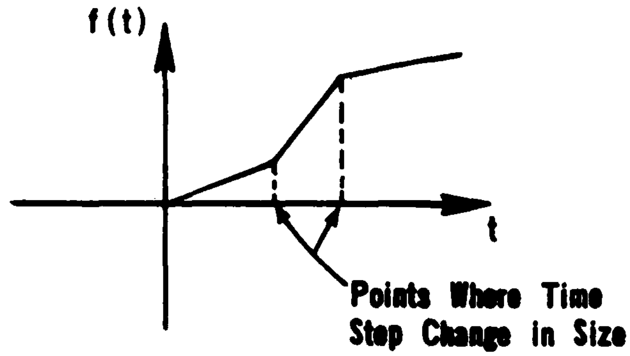
a) IH = -3



b) IH = -2

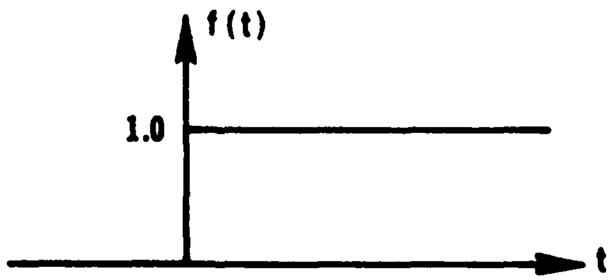


Equal Time Steps



Variable Time Steps

c) IH = -1



d) IH = 0

Figure 1. Built-in History Functions

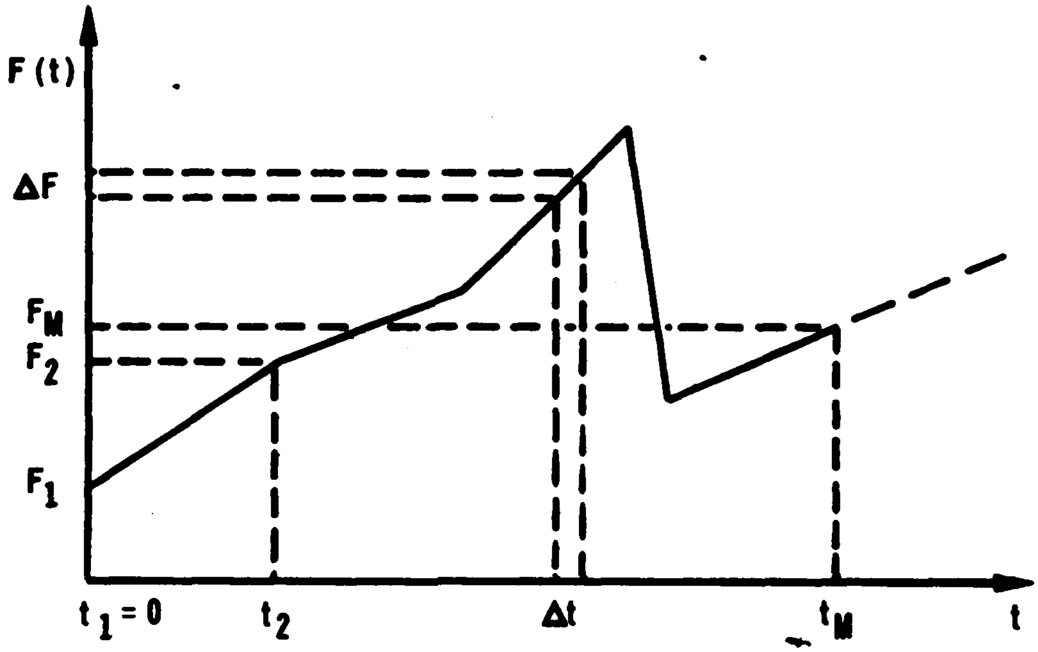


Figure 2. Typical User Specified History Function

Δt an incremental value of the quantity equal to $V^* \Delta F$ is applied, where ΔF corresponds to history function IH.

B2. Material Properties Array

The units of the material properties must be consistent with the units used to describe the geometry of the body and the magnitudes of the applied loads.

The material number **NMAT** serves as an identifier for use in Section B5 to assign a particular material description to a group of elements. In the current version of the program three types of material descriptions are permitted, i.e., isotropic or anisotropic, linear elastic and the bounding surface plasticity model for cohesive soils. Additional material models can be easily added to subroutine PROPTY by extending the two key "Block IF" statements as indicated in the program by comment statements.

As noted previously (in Section A3), the units of ρ_s and ρ_f must be compatible with the units selected for gravity "g".

Flow problems (IFLOW=1) can be stated either in terms of total or excess pore water pressure. In the first case ρ_f must be set equal to the fluid density (or unit weight - see previous paragraph); in the second case it is set equal to zero.

The quantity Γ can be viewed either as the combined bulk modulus of the soil particles and the pore water, or as a penalty number imposing an assumed incompressibility condition for these components [1, 2, 6]. In the absence of experimental evidence, the bulk modulus for water (3.2×10^5 psi, 2.2×10^9 N/m^2) may be used for Γ.

The "effective" permeability coefficients k^*_{ij} appear in Darcy's law† when units of pressure (not head) are used for the pore water pressure; their

† In terms of excess pore water pressure it has the form

$$v_1 = -(k^*_{11} \frac{\partial h}{\partial x_1} + k^*_{12} \frac{\partial h}{\partial x_2}), \text{ etc.}$$

relationships to the permeability coefficients commonly used by civil engineers and those used by physicists are discussed in [1].

For isotropic, linear elasticity E and ν denote Young's modulus and Poisson's ratio respectively. The linear, anisotropic elastic law is written in the form:

$$\begin{Bmatrix} \sigma_1' \\ \sigma_2' \\ \sigma_3' \\ \tau_{12}' \end{Bmatrix} = \begin{bmatrix} D_{11} & D_{12} & D_{13} & D_{14} \\ D_{12} & D_{22} & D_{23} & D_{24} \\ D_{13} & D_{23} & D_{33} & D_{34} \\ D_{14} & D_{24} & D_{34} & D_{44} \end{bmatrix} \begin{Bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \gamma_{12} \end{Bmatrix}$$

For plane (x-y) conditions the stress vectors is $<\sigma_x', \sigma_y', \sigma_z', \sigma_{xy}'>^T$, while for axisymmetry it is $<\sigma_r', \sigma_z', \sigma_\theta', \tau_{rz}'>^T$.

The meanings of the several parameters describing the bounding surface model are described in detail in ref [7-11]; values for particular soils may be found in [8, 11]; a summary of information is given in Table 1. In order to keep the input for the model exactly as described in [10], the parameter Γ is retained even though it is a duplication of previous input (the second value is not used).

B3. Initial State Information

The information in this section is used to establish the initial state of the soil. The values of h specified in this section are used directly to initialize the pore water pressure in the elements and indirectly to initialize it for the nodes; see Section B5. It is extremely important to note that σ_h and σ_v are "effective" stresses (total stress minus pore water pressure). It is assumed that the initial horizontal stress σ_h is the same in all directions and the initial shear stress (τ_{xy} or τ_{rz}) is zero. For linear elasticity problems the initial stresses may be taken to be zero and then the printed stresses are additions to the

Table 1 - Summary of Bounding Surface Model Parameters

Symbol	Description of Property	Value for Example Soil [11]	Range of typical values
λ	Slope of isotropic consolidation line for an e-ℓn p$'$ plot	.14	.1 → .4
κ	Slope of elastic rebound line for an e-ℓn p$'$ plot	.05	.02 → .08
M_c	Slope of critical state line in triaxial space (compression)	1.05	.75 → 1.3
R_c A_c T	Parameters describing shape of bounding surface (compression)	2.96 0.15 .08	2.0 → 3.0 .03 → .2 .05 → .15
P_ℓ	Transitional value of confining pressure separating linear rebound curves on e-ℓn p$'$ and e-p$'$ plots. Suggested range of values = $.3P_a \rightarrow 1.0P_a$	6.50 psi	4.0 → 15.0 psi
ν (or G)	Poisson's ratio (or shear modulus)*	(3960 psi)	.15 → .35 (1000 → 10000 psi)
P_a	Atmospheric pressure (used for scaling and establishing units)	14.7 psi	
Γ	Combined bulk modulus for soil particles and pore water	10^6 psi	$10^5 \rightarrow 10^7$ psi
m	Hardening parameter	0.1	0.1
h_c	Shape hardening parameter for compression	0.14	.05 → 2.0
h_2	Shape hardening parameter on the I-axis	.09	.05 → 2.0
$n=M_e/M_c$ $\mu=h_e/h_c$ $r=R_e/R_c$ $a=A_e/A_c$	Ratio of extension to compression values	.81 .31 .74 1.0	.75 → 1.2 .5 → 4.0 .70 → 1.3 .5 → 2.0
C	Projection center variable	.21	0 → .75
S	Elastic zone variable (a value of 1.0 gives no elastic zone)	1.0	1.0 → 2.0

* The user may directly input either ν or G

initial state (i.e., superposition is valid). However, if the bounding surface model is used, an accurate initiation of the stress state is extremely important.

It must be remembered that σ_v and σ_h are negative when compressive, while h is positive in compression. The units of h are those of stress. The question of whether h represents total or excess pore water pressure is discussed in Section A3.

The initial states are described by means of simple linear equations in depth y(z), thus the coefficients $a_1 \rightarrow e_2$ are dependent on the location selected for the origin of the coordinates.

A field example is shown in Figure 3. When a value of g = 1 is prescribed in Section A3, the analysis is in term of "total" pore water pressure. The vertical and horizontal soil stresses can be simply calculated from the soil weight and a assumed constant value of k_o = .45. The coordinate system is located as shown, and psi units are used. The following coefficients are found:

Zone 1:	Zone 2:	Zone 3:
a_1 = 12.1	a_1 = -11.4	a_1 = -20.9
a_2 = .028	a_2 = .025	a_2 = .058
b_1 = 5.4	b_1 = -5.1	b_1 = -9.4
b_2 = .013	b_2 = .011	b_2 = .026
c_1 = 10.4	c_1 = 10.4	c_1 = 0.
c_2 = -.036	c_2 = -.036	c_2 = 0.

The specifications of the initial void ratio e_i and the preconsolidation pressure (positive in compression) P_o are only necessary if the bounding surface model is used; they are "internal variables" for that theory [7].

B4. Node Point Array

The program incorporates two data generation routines to assist the user in defining the locations of the system's node points. The use of these options

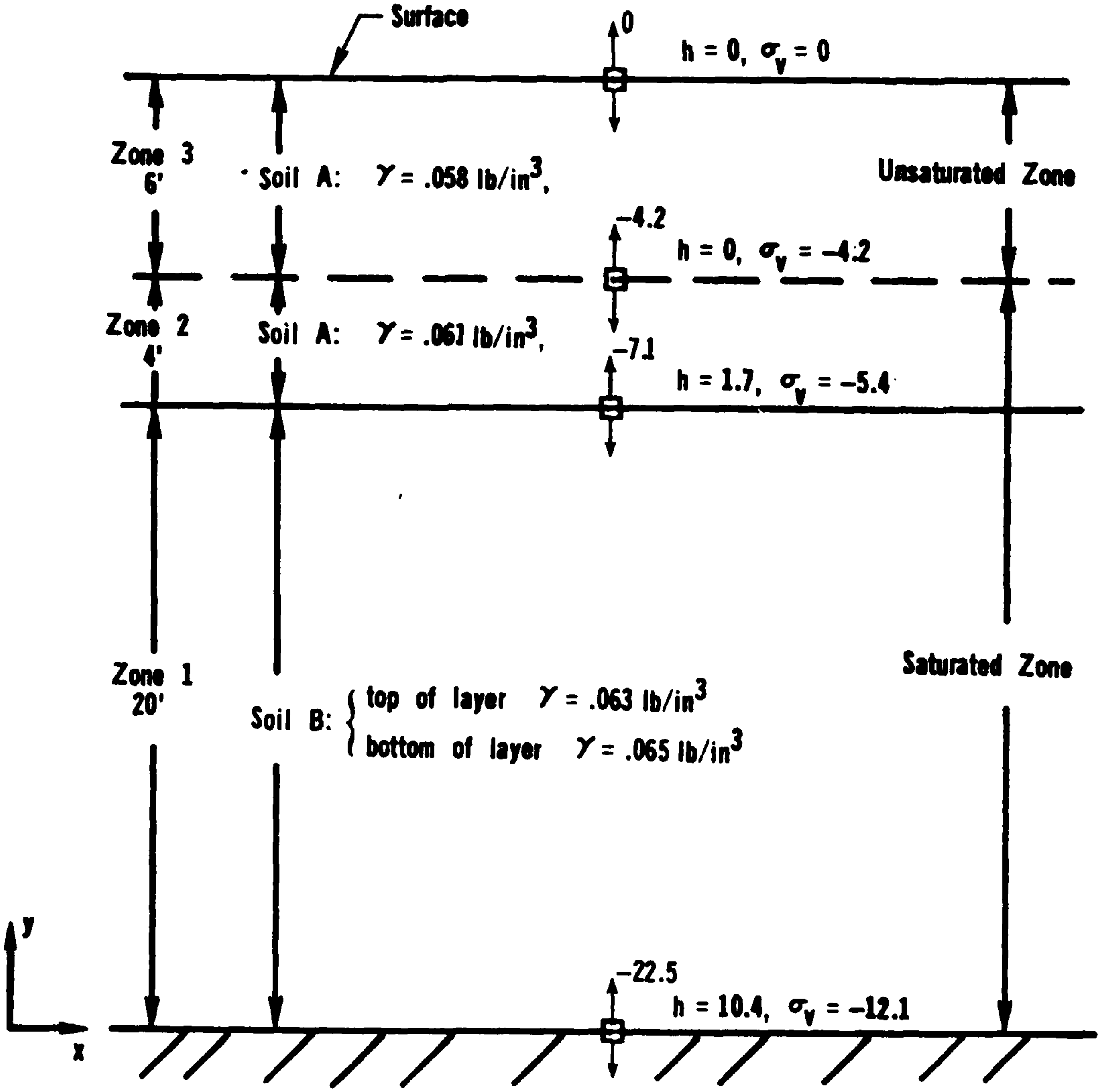


Figure 3. Example Soil Profile.

can, for example, enable one to describe the locations of the nodes of an arbitrarily large grid with as few as five cards. Note that not all numbers between 1 and the maximum node number NPT need correspond to actual nodes in the body. For example, the numbering scheme shown in Figure 4 is permissible; the coordinates of the non-existent nodes 15 and 21 need not be specified. This feature facilitates the use of the available node point and element generation options. If the location of a node is prescribed more than once in the input and the locations are not in agreement, the last description is used. However, if in a second or later description the node number is entered as negative, then the previous location is used. The utility of this option is illustrated later.

The straight line or circular arc coordinate generation option may be used whenever several sequential node points lie along a straight line or circular arc. If such a situation exists, it is necessary only to enter the coordinates of the initial and final points of the sequence (denoted by N' and N, respectively), and the values of INC and D. The constant INC represents the difference between any two successive node numbers in the sequence, and D defines the ratio of the distances between any two adjacent pairs of points.

If, for a node N, INC $\neq$ 0, intermediate node points are generated along a straight line (XC = YC = 0) or a circular arc (XC $\neq$ 0 and/or YC $\neq$ 0) between node N and the point described on the preceeding node specification card N'. That is, the coordinates of the points N' + INC, N' + 2*INC, . . ., N - INC are each automatically found. For the case of a circular arc (flagged by the condition XC $\neq$ and/or YC $\neq$ 0) it is assumed to pass through the end points of the sequence N' and N, and the additional intermediate point with coordinates (XC, YC). This intermediate point need not be a node. The node N for which the specified non-zero value of INC triggers the generation of the line N' - N can also serve as the initial point of a line generated between it and the point

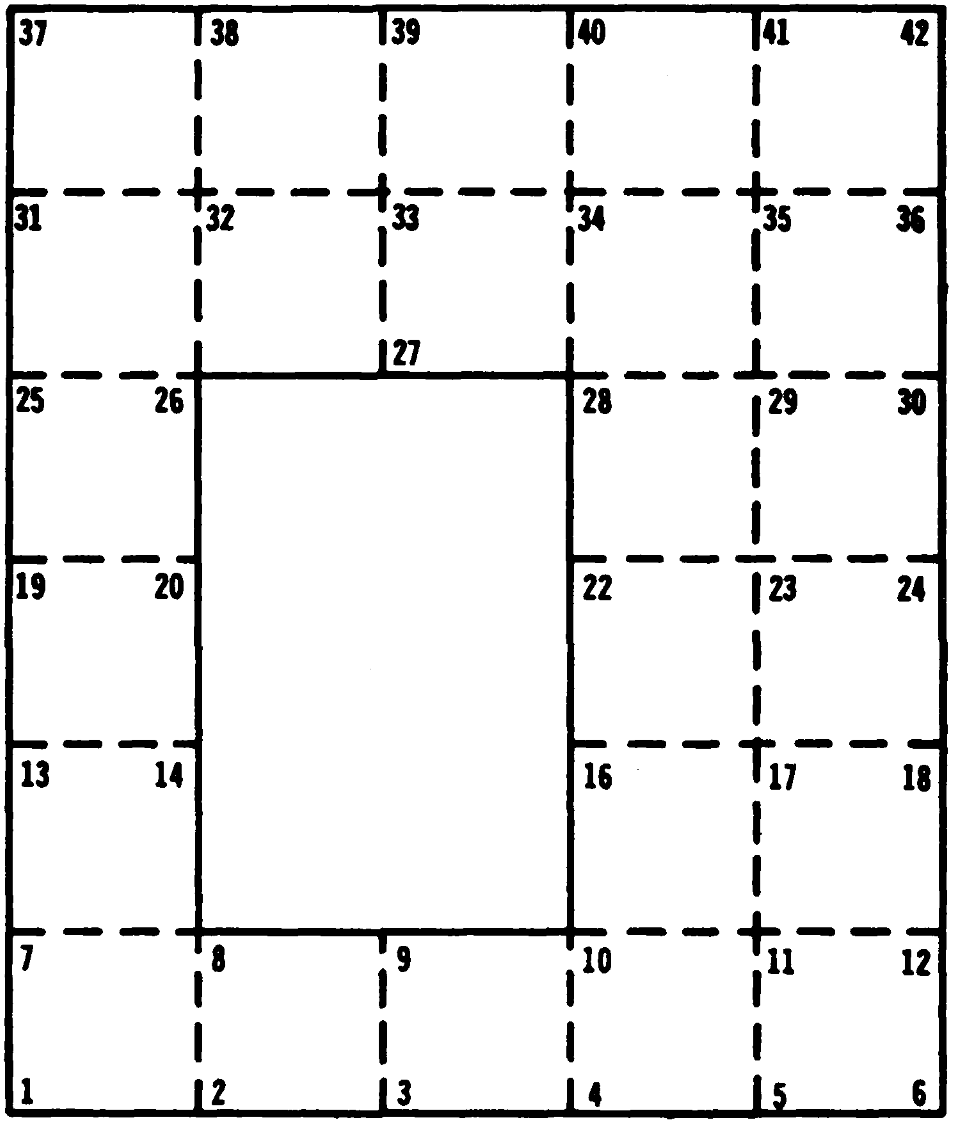


Figure 4. Example of a Grid with Missing Node Numbers

described on the next card. Thus the exterior nodes in Figure 4 can be generated with 5 cards for nodes 1, 6, 42, 37, and 1, with the last 4 having specified values for INC. If in the second specification, node 1 is entered as negative, then its coordinates do not need to be repeated.

The end points of the sequence may be entered in either order. For example, the segments illustrated in Figure 5 could be defined by specifying the nodes in either the order 7 → 22 (INC = 5, D = 2.0) or the order 22 → 7 (INC = -5, D = .5). The spacing of the intermediate points (nodes 12 and 17) is controlled by the spacing ratio D. A value of D = 1.0 would result in equally spaced nodes.

The interior node point generation option automatically (i.e. without any prompting by the user) locates all interior nodes whose coordinates have not been established through the options cited above (that is, all points left undefined after the input of Section B4 has been processed). The locations of these undefined interior nodes are computed by means of the "Laplacian - Isoparametric" grid generation scheme described in [3], See also Section A2. Note that all boundary nodes must be directly or indirectly specified by the input to Section B4.

Figure 6 illustrates two grids that have been prepared with the aid of the grid generation schemes. Grid 1 was developed by using the straight line generation routine to specify the exterior (boundary) nodes (only five cards were needed in Section B4). Grid 2 was developed in a similar manner, except that the straight line generation option was also used to define the nodes lying along the material interface, i.e., line 3 → 33. In the generation of line 3 → 33 the coordinates of nodes 3 and 33 previously specified by line generation 1 → 6 and 31 → 34 were used. This was accomplished by entering them as -3 and -33 (with blank x,y coordinates).

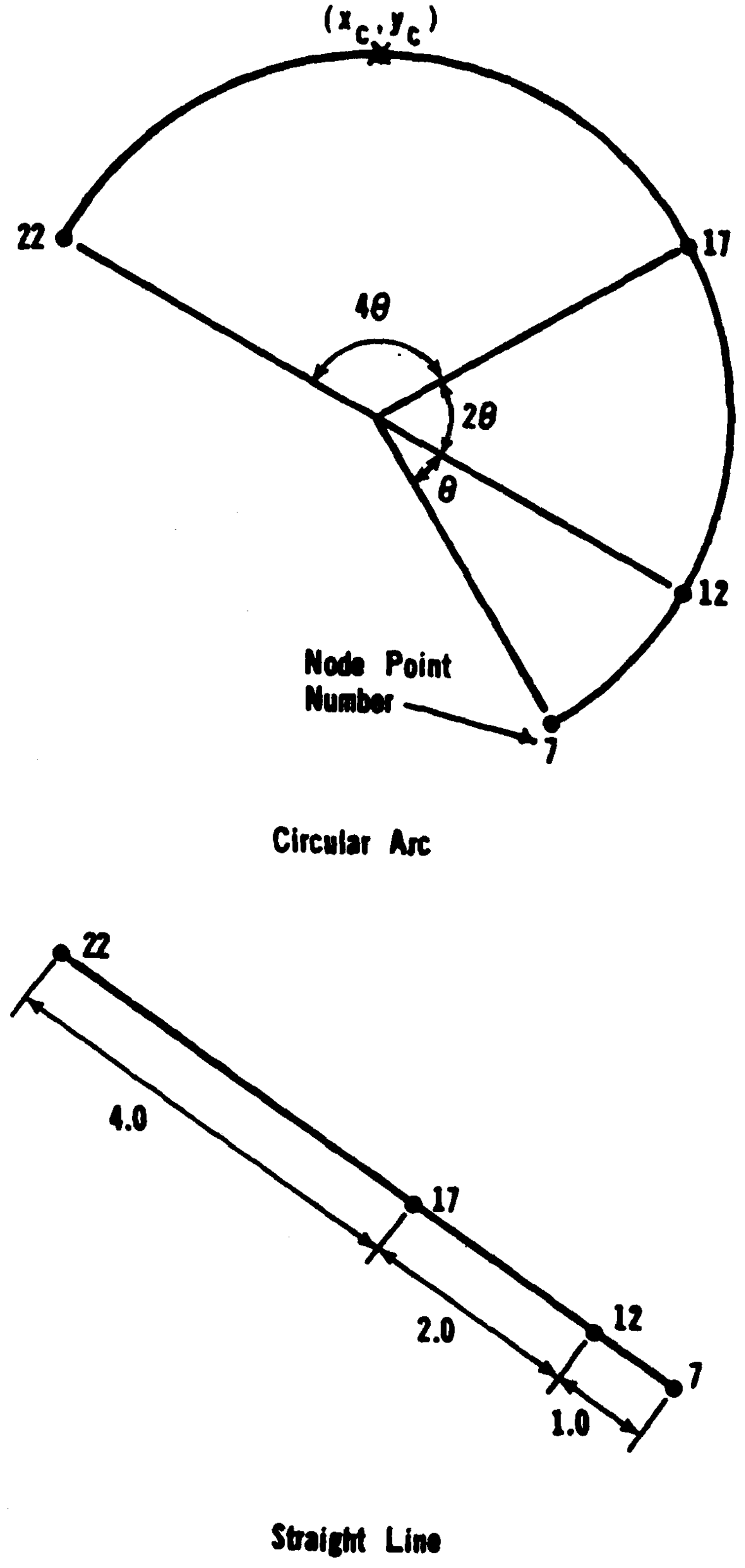
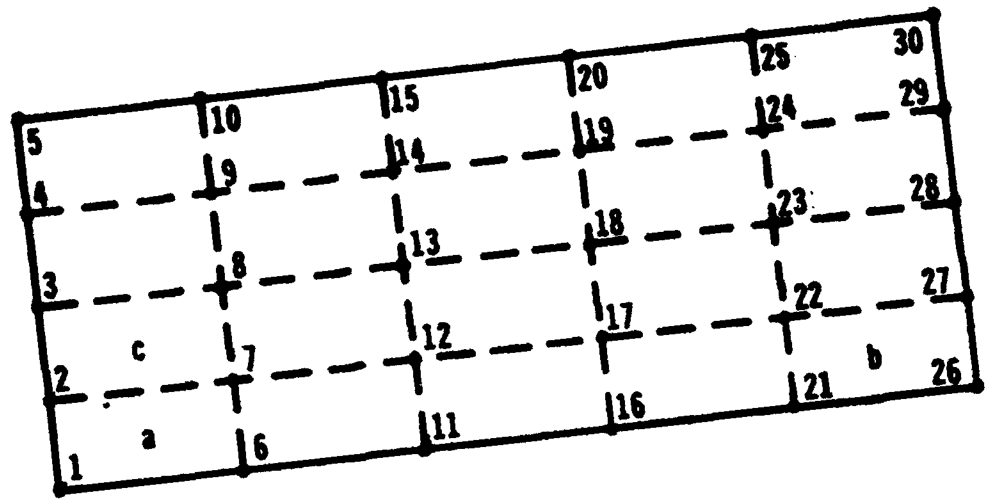
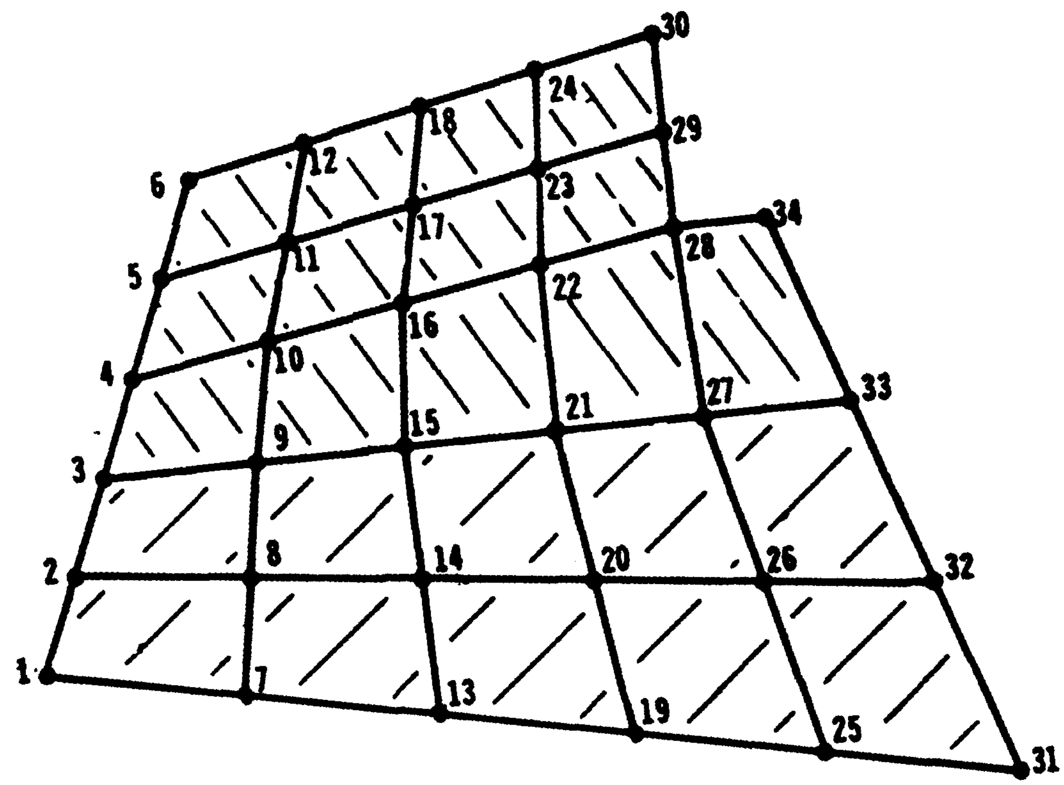


Figure 5. Examples of Line Generation



Grid #1



Grid #2

Figure 6. Grids Prepared with the Aid of the Generation Options.

B5. Element Array

The material number **MN** and the initial state number **ISNO** must correspond to the appropriate descriptions given in Sections B2 and B3. At the time the information for the initial state ISNO is used to initialize h for the element, it is also used to initialize h for the four nodes describing the element in question. If different initial states were prescribed for elements "a" and "c" of Figure 6 and they give initial values for h at the common nodes 2 and 7, which were not in agreement the values obtained from the element of higher number would prevail. Because in practice h is continuous such ambiguous situations should not often arise.

If the body can be divided into layers of elements, and if the material and the initial state numbers MN and ISNO are the same for several elements within a layer and for several layers, the node numbers of these elements can be simply established by means of the element data generation option. To generate a sequence of elements within a single layer, node points are specified for the first element only, together with appropriate values for **NMIS** and **INC.**

For example, the bottom row of elements in the first grid of Figure 6 could be established by entering either the node numbers of element "a" and the values NIMS = 4 and INC = 5 or the node numbers of element "b" and the values NMIS = 4 and INC = -5. Similarly, the left-most column of elements could be established by entering the node numbers of element "a" and the values NIMS = 3 and INC = 1, etc.

If several layers of elements are of the same material, and have the same initial state description it becomes possible to carry this option one step further. For example, the entire grid for the first example of Figure 6 could be established by entering the node numbers of element "a" and the values:

NMIS = 4

INC = 5

NMISP = 3

INCP = 1

or alternatively,

NMIS = 3

INC = 1

NMISP = 4

INCP = 5

Grids generated with these two specifications would differ only in the order that the elements were numbered.

Hence, under "ideal" conditions, the element array for an entire body can be defined with only a single card in Section B5.

B6. Node Point Specification Array

Boundary or interior node point displacement and load specifications may be given in terms of either x-y (r-z) components ($\theta_n = 0$ in Section B6) or local x_1-x_2 components ($\theta_n \neq 0$), see Figure 7. If $\theta_n = 0$, the subscripts 1 and 2 in Section B6 refer to x(r) and y(z) (and thus $IF_1 = IF_x$, etc.) and if $\theta_n \neq 0$ they represent x_1 and x_2 (and thus $IF_1 = IF_{x_1}$, etc.).

For each of the two coordinate directions, one may specify the history of either a displacement (IF = 1) or a load (IF = 0) by setting **V** equal to the magnitude of the applied quantity and IH equal to the appropriate history function number of Section B1. Specified displacements and loads are considered to be positive when they have the same sense as the positive coordinate directions. In addition, either the history of the water flow Q or the pore water pressure h may be specified by giving appropriate values for IH_3, IF_3 and V_3.

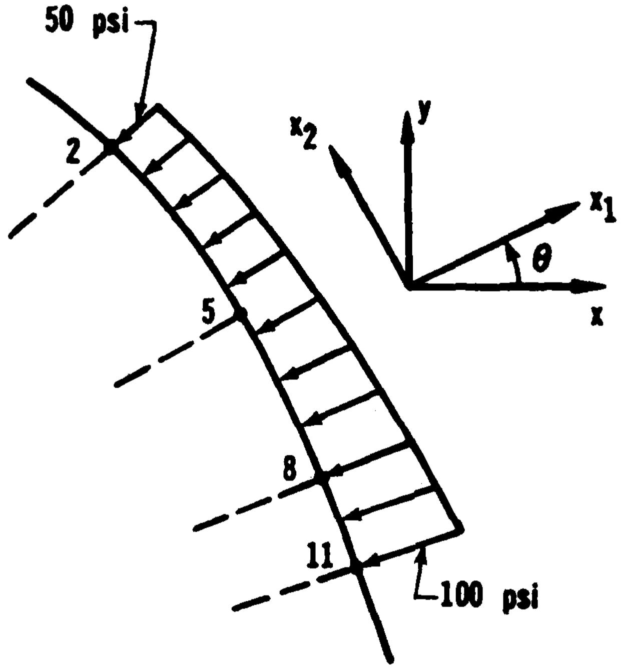


Figure 7. Pressurized Boundary and Example of Local Coordinates.

If several nodes in a sequence (N, N + INC, N + 2*INC, . . . N'-INC, N') all have the same "node point specifications", by supplying the appropriate values for **N, N'** and **INC** they can all be generated with a single card. A node point may have more than one specification as long as the accumulative effect on the system of equations is correct. For the same point, if one specification is a force and the other a displacement both in the x direction, displacement specification will prevail. If both specifications were displacements, the result would be the second. Multiple specifications which tend to cause difficulty, and thus should be avoided, are those which involve non-zero values of θ_n. Multiple specifications at corners are convenient, and should not be discouraged.

Using the generation option a uniform or linearly varying pressure may be specified along a straight or curved boundary (or an interior line). The quantities IF_1, IF_2, V_1, V_2 and θ_n are left blank and appropriate values for N, N', P_N and $P_{N'}$ are supplied. For example, to specify the boundary loading shown in Figure 7, the user would enter, on a single input card, the values:

$$\begin{aligned} N &= 11 \\ \theta_n &= 0. \\ N' &= 2 \\ INC &= -3 \\ P_N &= 100.0 \\ P_N' &= 50.0 \end{aligned}$$

For pressure specifications, the points N and N' must be given in a counter-clockwise order if they lie on an exterior boundary and in a clockwise order if they lie along an interior boundary (or "hole"). In general, pressure specification cards should preceed all other node point specifications in Section B6.

If for a given node, $IF_i = 0$, $V_i = 0$, $P_N = 0$ and $P_{N'} = 0$ it need not -and, for economy, should not -- be included in the node point specification array.

B7. Solution History Segment Information

The analysis is, in general, time dependent due to the consolidation process and the history dependence of the bounding surface plasticity model. For a non-flow problem (IFLOW = 0) the actual rate at which time passes is not important (because the bounding surface model is rate independent), however, for the purpose of modeling the history effects it is still convenient to think in terms of time. For a linear elastic, non-flow problem the only role of time is to represent the loading history; if only final results are desired then only one time step is required.

For convenience, the solution history is broken into one or more history segments. One card is required in Section B7 for each segment. The time at the end of a given segment is denoted as **TIME**; it is assumed that the first segment begins at $t = 0$. The number of time steps into which a given segment is to be divided is prescribed as **NMIS**. Within a given "history segment" the ratio of two successive time steps is equal to the prescribed spacing ratio **D**; a value of 1.0 gives equal time steps. The role of the time step spacing ratio is analogous to the length spacing ratio used in Section B4 and Figure 5.

The selection of appropriate time step lengths is complicated by the fact that two distinct processes are involved, i.e. water flow and soil plasticity. Thus a certain amount of experimentation with successively smaller time steps will often be required. In this process several factors should be considered. Abrupt changes in step size should be avoided (judicious use of the spacing ratio D can facilitate smooth transitions from small to large time steps, etc). Abrupt changes in applied loads or displacements will cause large flow gradients and require small time steps. Further information concerning step size for flow problems is to be found in [1, 2]. A certain amount of oscilation of the solution

is to be expected and usually can be tolerated. A minimum of 10-20 steps are usually required by the bounding surface plasticity model in proceeding from a nearly hydrostatic stress state to failure conditions.

C. End Card

The function of this card is to signal the end of the problem; the program then proceeds to the next stacked job (if any).

V. EXAMPLE

The following example is intended to illustrate the program input and output; the accuracy of the results is discussed in [1]. The problem configuration is shown in Figure 8. It is an idealized representation of the consolidation of a soil mass that is free to drain both from the top and a central sand drain. The input file and the output for the first 3 time steps are given in the Appendix.

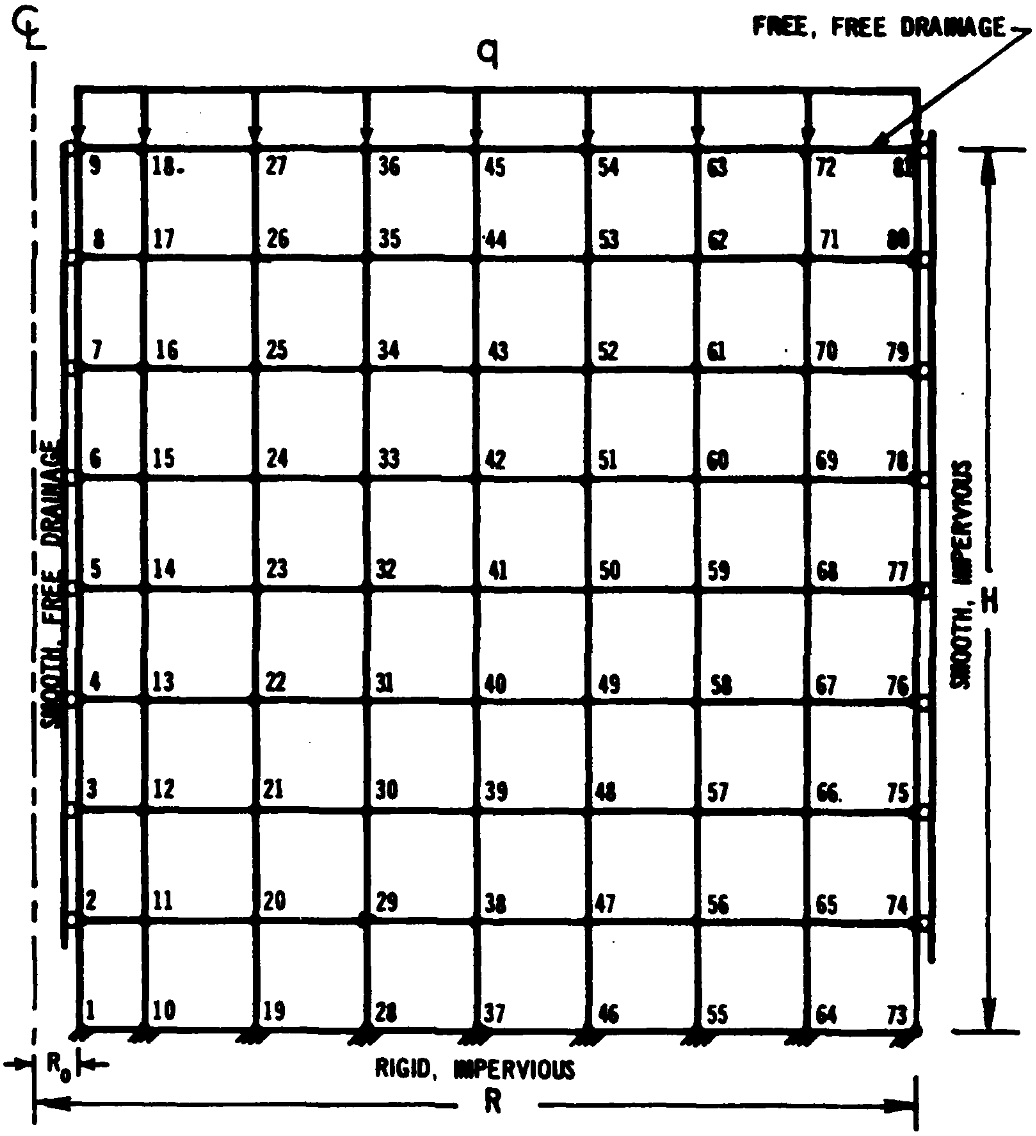


Figure 8. Example

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APPENDIX

Input File:

```
CASE # 4 ,GAMMA=INFINITY,8X8 ELEMS , AXISYMMETRIC ANALYSIS WITH WATER FLOW
   F   0.     1  0.5    2   0     1     1     1     0   81    64    36
  0          (    0.          0
   0
2
   1    1   3.7267    1.938      1.E+10   0.32      0.0        0.32
  200.        0.
4
   1   0.4        0.0
   9   0.4        8.0        1    1.0
  18   1.0        8.0        9    1.0
  81   8.0        8.0        9    1.0
  73   8.0        0.0       -1    1.0
  10   1.0        0.0       -9    1.0
  -1                        -9    1.0
5
   1    10    11    2    1    0    7    1    7    9
6
   9  0.0   0.0      0.0  0        0.1   0.0      0.0       81    9-100. -100.
   1 -2.1   0.0     -2.1  0                       0.0       73    9
   1 -2.1   0.0                    0.1   0.0      0.0        9    1
  73 -2.1   0.0                                   0.0       81    1
7
  18  13.1072    2.0
9
```

```
CASE # 4 , GAMMA=INFINITY, 8X8 ELEMS. , AXISYMMETRIC ANALYSIS WITH WATER FLOW


****************************************** MAXIMUM DIMENSION SPECIFICATIONS:
        NFUNMX=    1  IFUNSI=    1  MATMX=    1  NCOFMX=    0  NPTMX=   81  NELMX=   64  NDSPMX=   36


********** GRID GENERATION PARAMETER=      0.


***********TYPE OF TWO-DIMENSIONAL ANALYSIS********:

        -------AXISYMMETRIC ANALYSIS------


*******************DESCRIPTION OF THE HISTORIES OF THE MAGNITUDE AND DIRECTION OF GRAVITY:

        THE INITIAL VALUES OF GRAVITY AND THE ANGLE IT MAKES WITH THE X(R) AXIS ARE:  0.00 AND   0.00
        THE CORRESPONDING HISTORY FUNCTIONS ARE:  0 AND  0


********** SATURATED CONDITIONS-WATER MOVEMENT IS  ACCOUNTED FOR
        ---THE VALUE OF "ALPHA" USED IN INTEGRATING THE VOLUME TERM IS: 0.00
        ---THE VALUE OF "THETA" USED IN APPROXIMATING THE TIME DERIVATIVE IS: 0.50


**************LINEAR ANALYSIS*************



*************** DESCRIPTION OF MATERIAL PROPERTIES:

****THE DENSITIES FOR MATERIAL NO.  1  ARE: SOIL= 0.373E+01    FLUID= 0.194E+01
    FLUID AND PARTICLE BULK MODULUS= 0.100E+11
    EFFECTIVE PERMEABILITY COEFS ARE: K11= 0.320E+00  K12= 0.000E+00 AND K22= 0.320E+00

THE MATERIAL IS ISOTROPIC WITH E = 0.200E+03    AND POISSONS RATIO = 0.00
```

*****GEOMETRY*****

NODE POINT	X-Y OR R-Z COORDINATES	
1	4.00E-01	0.00E+00
2	4.00E-01	1.00E+00
3	4.00E-01	2.00E+00
4	4.00E-01	3.00E+00
5	4.00E-01	4.00E+00
6	4.00E-01	5.00E+00
7	4.00E-01	6.00E+00
8	4.00E-01	7.00E+00
9	4.00E-01	8.00E+00
10	1.00E+00	0.00E+00
11	1.00E+00	1.00E+00
12	1.00E+00	2.00E+00
13	1.00E+00	3.00E+00
14	1.00E+00	4.00E+00
15	1.00E+00	5.00E+00
16	1.00E+00	6.00E+00
17	1.00E+00	7.00E+00
18	1.00E+00	8.00E+00
19	2.00E+00	0.00E+00
20	2.00E+00	1.00E+00
21	2.00E+00	2.00E+00
22	2.00E+00	3.00E+00
23	2.00E+00	4.00E+00
24	2.00E+00	5.00E+00
25	2.00E+00	6.00E+00
26	2.00E+00	7.00E+00
27	2.00E+00	8.00E+00
28	3.00E+00	0.00E+00
29	3.00E+00	1.00E+00
30	3.00E+00	2.00E+00
31	3.00E+00	3.00E+00
32	3.00E+00	4.00E+00
33	3.00E+00	5.00E+00
34	3.00E+00	6.00E+00
35	3.00E+00	7.00E+00
36	3.00E+00	8.00E+00
37	4.00E+00	0.00E+00
38	4.00E+00	1.00E+00
39	4.00E+00	2.00E+00
40	4.00E+00	3.00E+00
41	4.00E+00	4.00E+00
42	4.00E+00	5.00E+00
43	4.00E+00	6.00E+00
44	4.00E+00	7.00E+00
45	4.00E+00	8.00E+00
46	5.00E+00	0.00E+00
47	5.00E+00	1.00E+00
48	5.00E+00	2.00E+00
49	5.00E+00	3.00E+00
50	5.00E+00	4.00E+00
51	5.00E+00	5.00E+00
52	5.00E+00	6.00E+00
53	5.00E+00	7.00E+00
54	5.00E+00	8.00E+00
55	6.00E+00	0.00E+00
56	6.00E+00	1.00E+00
57	6.00E+00	2.00E+00
58	6.00E+00	3.00E+00
59	6.00E+00	4.00E+00
60	6.00E+00	5.00E+00
61	6.00E+00	6.00E+00
62	6.00E+00	7.00E+00
63	6.00E+00	8.00E+00
64	7.00E+00	0.00E+00
65	7.00E+00	1.00E+00
66	7.00E+00	2.00E+00
67	7.00E+00	3.00E+00
68	7.00E+00	4.00E+00
69	7.00E+00	5.00E+00
70	7.00E+00	6.00E+00
71	7.00E+00	7.00E+00
72	7.00E+00	8.00E+00
73	8.00E+00	0.00E+00
74	8.00E+00	1.00E+00
75	8.00E+00	2.00E+00
76	8.00E+00	3.00E+00
77	8.00E+00	4.00E+00
78	8.00E+00	5.00E+00
79	8.00E+00	6.00E+00
80	8.00E+00	7.00E+00
81	8.00E+00	8.00E+00

ELEMENT NUMBER	ELEMENT CENTER		ELEMENT NODE POINTS				MATERIAL NUMBER	INITIAL STATE SIG-V	SIG-H	h	PRECON P	INIT VO
1	7.000E-01	5.000E-01	1	10	11	2	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
2	7.000E-01	1.500E+00	2	11	12	3	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
3	7.000E-01	2.500E+00	3	12	13	4	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
4	7.000E-01	3.500E+00	4	13	14	5	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
5	7.000E-01	4.500E+00	5	14	15	6	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
6	7.000E-01	5.500E+00	6	15	16	7	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
7	7.000E-01	6.500E+00	7	16	17	8	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
8	7.000E-01	7.500E+00	8	17	18	9	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
9	1.500E+00	5.000E-01	10	19	20	11	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
10	1.500E+00	1.500E+00	11	20	21	12	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
11	1.500E+00	2.500E+00	12	21	22	13	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
12	1.500E+00	3.500E+00	13	22	23	14	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
13	1.500E+00	4.500E+00	14	23	24	15	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
14	1.500E+00	5.500E+00	15	24	25	16	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
15	1.500E+00	6.500E+00	16	25	26	17	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
16	1.500E+00	7.500E+00	17	26	27	18	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
17	2.500E+00	5.000E-01	19	28	29	20	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
18	2.500E+00	1.500E+00	20	29	30	21	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
19	2.500E+00	2.500E+00	21	30	31	22	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
20	2.500E+00	3.500E+00	22	31	32	23	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
21	2.500E+00	4.500E+00	23	32	33	24	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
22	2.500E+00	5.500E+00	24	33	34	25	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
23	2.500E+00	6.500E+00	25	34	35	26	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
24	2.500E+00	7.500E+00	26	35	36	27	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
25	3.500E+00	5.000E-01	28	37	38	29	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
26	3.500E+00	1.500E+00	29	38	39	30	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
27	3.500E+00	2.500E+00	30	39	40	31	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
28	3.500E+00	3.500E+00	31	40	41	32	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
29	3.500E+00	4.500E+00	32	41	42	33	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
30	3.500E+00	5.500E+00	33	42	43	34	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
31	3.500E+00	6.500E+00	34	43	44	35	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
32	3.500E+00	7.500E+00	35	44	45	36	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
33	4.500E+00	5.000E-01	37	46	47	38	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
34	4.500E+00	1.500E+00	38	47	48	39	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
35	4.500E+00	2.500E+00	39	48	49	40	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
36	4.500E+00	3.500E+00	40	49	50	41	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
37	4.500E+00	4.500E+00	41	50	51	42	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
38	4.500E+00	5.500E+00	42	51	52	43	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
39	4.500E+00	6.500E+00	43	52	53	44	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
40	4.500E+00	7.500E+00	44	53	54	45	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
41	5.500E+00	5.000E-01	46	55	56	47	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
42	5.500E+00	1.500E+00	47	56	57	48	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
43	5.500E+00	2.500E+00	48	57	58	49	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
44	5.500E+00	3.500E+00	49	58	59	50	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
45	5.500E+00	4.500E+00	50	59	60	51	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
46	5.500E+00	5.500E+00	51	60	61	52	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
47	5.500E+00	6.500E+00	52	61	62	53	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
48	5.500E+00	7.500E+00	53	62	63	54	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
49	6.500E+00	5.000E-01	55	64	65	56	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
50	6.500E+00	1.500E+00	56	65	66	57	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
51	6.500E+00	2.500E+00	57	66	67	58	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
52	6.500E+00	3.500E+00	58	67	68	59	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
53	6.500E+00	4.500E+00	59	68	69	60	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
54	6.500E+00	5.500E+00	60	69	70	61	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
55	6.500E+00	6.500E+00	61	70	71	62	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
56	6.500E+00	7.500E+00	62	71	72	63	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
57	7.500E+00	5.000E-01	64	73	74	65	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
58	7.500E+00	1.500E+00	65	74	75	66	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
59	7.500E+00	2.500E+00	66	75	76	67	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
60	7.500E+00	3.500E+00	67	76	77	68	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
61	7.500E+00	4.500E+00	68	77	78	69	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
62	7.500E+00	5.500E+00	69	78	79	70	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
63	7.500E+00	6.500E+00	70	79	80	71	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00
64	7.500E+00	7.500E+00	71	80	81	72	1	0.000E+00	0.000E+00	0.000E+00	0.00	0.00

*****NODE POINT SPECFICATIONS*****

NODE						
9	P-R= 0.00E+00	IH1= 0	P-Z= -1.80E+01	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
18	P-R= 0.00E+00	IH1= 0	P-Z= -9.07E+01	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
27	P-R= 0.00E+00	IH1= 0	P-Z= -2.00E+02	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
36	P-R= 0.00E+00	IH1= 0	P-Z= -3.00E+02	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
45	P-R= 0.00E+00	IH1= 0	P-Z= -4.00E+02	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
54	P-R= 0.00E+00	IH1= 0	P-Z= -5.00E+02	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
63	P-R= 0.00E+00	IH1= 0	P-Z= -6.00E+02	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
72	P-R= 0.00E+00	IH1= 0	P-Z= -7.00E+02	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
81	P-R= 0.00E+00	IH1= 0	P-Z= -3.83E+02	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
1	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
10	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
19	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
28	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
37	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
46	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
55	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
64	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
73	U-R= 0.00E+00	IH1= -2	U-Z= 0.00E+00	IH2= -2	Q= 0.00E+00	IH3= 0	ANG= 0
1	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
2	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
3	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
4	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
5	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
6	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
7	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
8	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
9	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	h= 0.00E+00	IH3= 0	ANG= 0
73	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
74	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
75	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
76	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
77	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
78	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
79	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
80	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0
81	U-R= 0.00E+00	IH1= -2	P-Z= 0.00E+00	IH2= 0	Q= 0.00E+00	IH3= 0	ANG= 0

TIME 0.00005 NO ITERATION WAS REQUIRED

EMENT

ELEMENT STRAINS AND STRESSES

NO	EPSILON-R	EPSILON-Z	EPS-THETA	GAMMA-RZ	SIGMA-R	SIGMA-Z	SIG-THETA	TAU-RZ	h
1	-4.747E-02	-9.350E-03	-2.034E-02	-1.991E-02	-9.494E+00	-1.870E+00	-4.069E+00	-1.991E+00	7.188E+01
2	-8.989E-02	-3.985E-03	-3.853E-02	1.088E-02	-1.798E+01	-7.970E-01	-7.705E+00	1.088E+00	7.212E+01
3	-8.444E-02	8.016E-03	-3.619E-02	1.429E-03	-1.699E+01	1.603E+00	-7.238E+00	1.429E-01	7.592E+01
4	-8.392E-02	-1.381E-02	-3.597E-02	7.407E-04	-1.678E+01	-2.763E+00	-7.193E+00	7.407E-02	7.251E+01
5	-8.319E-02	1.294E-02	-3.565E-02	1.493E-03	-1.664E+01	2.587E+00	-7.131E+00	1.493E-01	7.769E+01
6	-8.087E-02	-2.967E-02	-3.466E-02	4.283E-03	-1.617E+01	-5.934E+00	-6.932E+00	4.283E-01	7.079E+01
7	-7.653E-02	1.753E-02	-3.280E-02	5.095E-03	-1.531E+01	3.506E+00	-6.560E+00	5.095E-01	8.184E+01
8	-8.926E-02	-7.388E-02	-3.825E-02	5.397E-02	-1.785E+01	-1.478E+01	-7.651E+00	5.397E+00	6.968E+01
9	3.069E-02	-1.616E-03	-8.758E-03	-2.369E-02	6.138E+00	-3.231E-01	-1.752E+00	-2.368E+00	1.072E+02
10	5.504E-02	-9.698E-03	-1.761E-02	4.759E-03	1.101E+01	-1.940E+00	-3.522E+00	4.759E-01	1.043E+02
11	4.895E-02	7.995E-03	-1.746E-02	4.056E-03	9.790E+00	1.599E+00	-3.492E+00	4.056E-01	1.082E+02
12	4.985E-02	-1.488E-02	-1.695E-02	3.313E-03	9.971E+00	-2.975E+00	-3.390E+00	3.313E-01	1.036E+02
13	5.047E-02	1.429E-02	-1.646E-02	3.259E-03	1.009E+01	2.859E+00	-3.291E+00	3.259E-01	1.105E+02
14	5.059E-02	-2.653E-02	-1.549E-02	7.985E-03	1.012E+01	-5.306E+00	-3.097E+00	7.985E-01	1.021E+02
15	5.011E-02	2.196E-02	-1.391E-02	1.573E-02	1.002E+01	4.392E+00	-2.781E+00	1.573E+00	1.135E+02
16	5.505E-02	-3.238E-02	-1.735E-02	1.045E-02	1.101E+01	-6.476E+00	-3.471E+00	1.045E+00	1.021E+02
17	-7.983E-03	5.151E-04	-7.130E-04	-4.022E-03	-1.597E+00	1.030E-01	-1.426E-01	-4.022E-01	9.679E+01
18	-1.307E-02	-7.841E-03	-2.171E-03	-2.655E-03	-2.613E+00	-1.568E+00	-4.343E-01	-2.655E-01	9.586E+01
19	-1.100E-02	6.083E-03	-2.885E-03	2.910E-03	-2.200E+00	1.217E+00	-5.770E-01	2.910E-01	9.805E+01
20	-1.244E-02	-1.374E-02	-2.688E-03	3.576E-03	-2.489E+00	-2.749E+00	-5.376E-01	3.576E-01	9.445E+01
21	-1.257E-02	1.400E-02	-2.294E-03	4.708E-03	-2.514E+00	2.799E+00	-4.587E-01	4.708E-01	9.955E+01
22	-1.320E-02	-2.163E-02	-1.812E-03	6.197E-03	-2.640E+00	-4.327E+00	-3.625E-01	6.197E-01	9.338E+01
23	-1.677E-02	2.557E-02	-1.675E-03	5.452E-03	-3.353E+00	5.114E+00	-3.349E-01	5.452E-01	1.013E+02
24	-1.653E-02	-3.019E-02	-2.707E-03	-2.890E-03	-3.306E+00	-6.038E+00	-5.415E-01	-2.890E-01	8.978E+01
25	7.290E-03	8.349E-04	-6.083E-04	-3.481E-03	1.458E+00	1.670E-01	-1.217E-01	-3.481E-01	1.026E+02
26	1.394E-02	-6.324E-03	-1.426E-03	-3.803E-04	2.788E+00	-1.265E+00	-2.852E-01	-3.803E-02	1.011E+02
27	1.341E-02	6.662E-03	-1.717E-03	9.305E-04	2.681E+00	1.332E+00	-3.434E-01	9.305E-02	1.038E+02
28	1.364E-02	-1.359E-02	-1.749E-03	2.586E-03	2.729E+00	-2.719E+00	-3.497E-01	2.586E-01	9.954E+01
29	1.286E-02	1.518E-02	-1.597E-03	3.470E-03	2.572E+00	3.036E+00	-3.193E-01	3.470E-01	1.056E+02
30	1.194E-02	-2.110E-02	-1.474E-03	3.245E-03	2.389E+00	-4.219E+00	-2.948E-01	3.245E-01	9.760E+01
31	1.330E-02	2.551E-02	-1.692E-03	8.305E-04	2.659E+00	5.102E+00	-3.384E-01	8.305E-02	1.077E+02
32	1.424E-02	-3.251E-02	-2.261E-03	2.113E-03	2.847E+00	-6.503E+00	-4.523E-01	2.113E-01	9.583E+01
33	-3.392E-03	1.410E-03	-3.989E-05	-5.608E-04	-6.783E-01	2.821E-01	-7.979E-03	-5.608E-02	9.921E+01
34	-5.879E-03	-6.070E-03	-2.131E-04	-8.804E-04	-1.176E+00	-1.214E+00	-4.263E-02	-8.804E-02	9.775E+01
35	-4.919E-03	7.527E-03	-3.924E-04	6.068E-04	-9.838E-01	1.505E+00	-7.848E-02	6.068E-02	1.004E+02
36	-5.265E-03	-1.326E-02	-4.291E-04	1.572E-03	-1.053E+00	-2.652E+00	-8.583E-02	1.572E-01	9.629E+01
37	-5.402E-03	1.560E-02	-4.130E-04	1.786E-03	-1.080E+00	3.120E+00	-8.261E-02	1.786E-01	1.018E+02
38	-5.527E-03	-2.115E-02	-4.337E-04	1.497E-03	-1.105E+00	-4.230E+00	-8.674E-02	1.497E-01	9.475E+01
39	-6.256E-03	2.506E-02	-5.336E-04	1.190E-03	-1.251E+00	5.012E+00	-1.067E-01	1.190E-01	1.034E+02
40	-5.322E-03	-3.168E-02	-7.683E-04	-1.174E-03	-1.064E+00	-6.336E+00	-1.537E-01	-1.174E-01	9.231E+01
41	2.580E-03	1.412E-03	-1.064E-04	-9.671E-04	5.160E-01	2.825E-01	-2.129E-02	-9.671E-02	1.012E+02
42	5.013E-03	-5.395E-03	-2.531E-04	-8.283E-05	1.003E+00	-1.079E+00	-5.061E-02	-8.283E-03	9.992E+01
43	4.902E-03	7.763E-03	-3.225E-04	2.484E-04	9.805E-01	1.553E+00	-6.451E-02	2.484E-02	1.025E+02
44	5.107E-03	-1.277E-02	-3.655E-04	6.786E-04	1.021E+00	-2.553E+00	-7.310E-02	6.786E-02	9.838E+01
45	4.923E-03	1.557E-02	-3.815E-04	1.026E-03	9.845E-01	3.113E+00	-7.630E-02	1.026E-01	1.041E+02
46	4.916E-03	-2.112E-02	-4.104E-04	7.384E-04	9.831E-01	-4.223E+00	-8.208E-02	7.384E-02	9.648E+01
47	5.627E-03	2.499E-02	-4.938E-04	2.740E-04	1.125E+00	4.997E+00	-9.876E-02	2.740E-02	1.061E+02
48	5.507E-03	-3.224E-02	-6.118E-04	1.151E-03	1.101E+00	-6.447E+00	-1.224E-01	1.151E-01	9.433E+01
49	-1.145E-03	1.594E-03	2.030E-05	2.418E-04	-2.290E-01	3.188E-01	4.061E-03	2.418E-02	1.000E+02
50	-2.031E-03	-5.324E-03	1.526E-05	-2.547E-04	-4.062E-01	-1.065E+00	3.051E-03	-2.547E-02	9.859E+01
51	-1.676E-03	8.120E-03	-2.471E-05	1.018E-04	-3.351E-01	1.624E+00	-4.941E-03	1.018E-02	1.013E+02
52	-1.673E-03	-1.270E-02	-4.511E-05	3.841E-04	-3.346E-01	-2.540E+00	-9.021E-03	3.841E-02	9.712E+01
53	-1.545E-03	1.573E-02	-6.298E-05	3.114E-04	-3.090E-01	3.146E+00	-1.260E-02	3.114E-02	1.027E+02
54	-1.498E-03	-2.120E-02	-8.441E-05	4.477E-04	-2.997E-01	-4.240E+00	-1.688E-02	4.477E-02	9.545E+01
55	-1.656E-03	2.492E-02	-1.123E-04	3.043E-04	-3.311E-01	4.983E+00	-2.246E-02	3.043E-02	1.044E+02
56	-9.618E-04	-3.205E-02	-1.681E-04	-7.464E-04	-1.924E-01	-6.409E+00	-3.362E-02	-7.464E-02	9.321E+01
57	4.406E-04	1.605E-03	-2.937E-05	-4.079E-04	8.811E-02	3.209E-01	-5.874E-03	-4.079E-02	1.005E+02
58	9.162E-04	-5.190E-03	-6.108E-05	4.442E-05	1.832E-01	-1.038E+00	-1.222E-02	4.442E-03	9.918E+01
59	9.984E-04	8.224E-03	-6.656E-05	5.220E-05	1.997E-01	1.645E+00	-1.331E-02	5.220E-03	1.019E+02
60	1.130E-03	-1.265E-02	-7.532E-05	2.082E-06	2.260E-01	-2.529E+00	-1.506E-02	2.082E-04	9.767E+01
61	1.182E-03	1.582E-02	-7.878E-05	2.535E-04	2.364E-01	3.165E+00	-1.576E-02	2.535E-02	1.034E+02
62	1.278E-03	-2.134E-02	-8.653E-05	-7.528E-05	2.596E-01	-4.268E+00	-1.731E-02	-7.528E-03	9.586E+01
63	1.558E-03	2.507E-02	-1.039E-04	2.846E-06	3.116E-01	5.015E+00	-2.077E-02	2.846E-04	1.052E+02
64	1.574E-03	-3.238E-02	-1.049E-04	8.426E-04	3.147E-01	-6.476E+00	-2.098E-02	8.426E-02	9.364E+01

NODE NO	DISPLACEMENTS U	V
1	-1.655E-19	-1.426E-19
2	-3.780E-19	-1.450E-02
3	-4.026E-19	-1.290E-02
4	-3.994E-19	-6.465E-03
5	-4.021E-19	-1.839E-02
6	-3.966E-19	-7.612E-03
7	-4.011E-19	-3.641E-02
8	-3.911E-19	-1.991E-02
9	-2.069E-19	-1.286E-01
10	-1.429E-19	-9.003E-19
11	-5.696E-02	-4.204E-03
12	-5.091E-02	-1.377E-02
13	-5.042E-02	-4.172E-03
14	-5.029E-02	-1.987E-02
15	-4.955E-02	-4.780E-03
16	-4.750E-02	-3.533E-02
17	-4.433E-02	-1.677E-02
18	-6.278E-02	-5.587E-02
19	5.078E-20	-2.012E-18
20	4.419E-03	9.725E-04
21	-2.210E-03	-8.856E-03
22	-1.213E-03	-2.464E-03
23	2.166E-04	-1.652E-02
24	8.838E-04	-3.022E-03
25	3.253E-03	-2.553E-02
26	5.140E-03	-1.694E-04
27	-2.147E-03	-2.583E-02
28	-7.523E-20	-2.998E-18
29	-1.155E-02	5.771E-05
30	-1.237E-02	-5.797E-03
31	-1.305E-02	-2.287E-05
32	-1.283E-02	-1.346E-02
33	-1.120E-02	1.040E-03
34	-1.106E-02	-1.972E-02
35	-1.408E-02	6.059E-03
36	-1.598E-02	-2.865E-02
37	4.046E-20	-4.016E-18
38	3.033E-03	1.612E-03
39	9.277E-04	-5.181E-03
40	4.597E-04	2.369E-03
41	9.432E-04	-1.138E-02
42	7.417E-04	4.478E-03
43	8.821E-04	-1.695E-02
44	5.720E-04	8.291E-03
45	-2.164E-03	-2.202E-02
46	-3.790E-20	-5.001E-18
47	-3.751E-03	1.209E-03
48	-4.046E-03	-4.138E-03
49	-4.404E-03	3.366E-03
50	-4.723E-03	-9.400E-03
51	-4.396E-03	5.943E-03
52	-[illegible].034E-03	-1.493E-02
53	-[illegible].025E-03	9.945E-03
54	-[illegible].212E-03	-2.310E-02
55	2.131E-20	-6.012E-18
56	1.409E-03	1.616E-03
57	8.201E-04	-3.827E-03
58	5.343E-04	4.196E-03
59	[illegible].525E-04	-8.572E-03
60	[illegible].735E-04	7.218E-03
61	2.276E-04	-1.414E-02
62	-3.181E-05	1.096E-02
63	-1.192E-03	-2.047E-02
64	-1.192E-20	-7.000E-18
65	-8.811E-04	1.572E-03
66	-9.513E-04	-3.633E-03
67	-1.046E-03	4.585E-03
68	-1.214E-03	-8.043E-03
69	-1.150E-03	7.626E-03
70	-1.446E-03	-1.341E-02
71	-1.669E-03	1.132E-02
72	-1.478E-03	-2.135E-02
73	4.017E-18	-3.839E-18
74	7.977E-18	1.637E-03
75	8.027E-18	-3.539E-03
76	7.965E-18	4.690E-03
77	8.024E-18	-7.979E-03
78	7.950E-18	8.001E-03
79	8.022E-18	-1.364E-02
80	7.933E-18	1.178E-02
81	3.731E-18	-2.031E-02

‾ TIME 0 00015 NO ITERATION WAS REQUIRED

_FMENT ELEMENT STRAINS AND STRESSES

NO.	EPSILON-R	EPSILON-Z	EPS-THETA	GAMMA-RZ	SIGMA-R	SIGMA-Z	SIG-THETA	TAU-RZ	h
1	-7.471E-02	-1.723E-02	-3.202E-02	-3.254E 02	-1.494E+01	-3 447E+00	-6 404E+00	-3.254E+00	5.513E+01
2	-1.450E-01	-3 899E-03	-6.215E-02	1.270E 02	-2.900E+01	-7.798E-01	-1.243E+01	1.270E+00	5.522E+01
3	-1.405E-01	1.164E-02	-6 023E-02	1.789E 03	-2.811E+01	2.327E+00	-1.205E+01	1.789E-01	5.932E+01
4	-1.411E 01	-2.274E-02	-6.047E-02	-1.354E 04	-2 822E+01	-4 549E+00	-1.209E+01	-1 354E-02	5.404E+01
5	-1.394E 01	2.284E-02	-5.975E-02	4 816E 03	-2 788E+01	4.567E+00	-1 195E+01	4.816E-01	6.238E+01
6	-1 378E-01	-5.165E-02	-5.905E-02	3 284E 04	-2.756E+01	-1 033E+01	-1.181E+01	3.284E-02	5 077E+01
7	-1.268E-01	3.400E-02	-5.435E-02	1.979E 02	-2.536E+01	6.801E+00	-1 087E+01	1 979E+00	6.838E+01
8	-1 186E-01	-1.268E-01	-5.083E-02	8.263E 02	-2.372E+01	-2.536E+01	-1.017E+01	8.263E+00	5 442E+01
9	4.454E-02	-3 785E-03	-1 504E 02	-3.904E-02	8 909E+00	-7.570E-01	-3 007E+00	-3 904E+00	1 087E+02
10	8 228E-02	-1 566E-02	-3.058E-02	7.585E 03	1.646E+01	-3 132E+00	-6 115E+00	7 585E-01	1.054E+02
11	7.622E 02	1.479E-02	-3.081E-02	6 275E-03	1.524E+01	2.958E+00	-6.163E+00	6.275E-01	1.124E+02
12	7.817E-02	-2 878E-02	-3 038E-02	3.989E-03	1.563E+01	-5.757E+00	-6.076E+00	3 989E-01	1 037E+02
13	7.874E-02	3.204E-02	-2.952E-02	6.825E-03	1 575E+01	6 408E+00	-5.904E+00	6.825E-01	1.175E+02
14	8.085E-02	-5 946E-02	-2 817E-02	9.714E 03	1.617E+01	-1.189E+01	-5.634E+00	9 714E-01	9.892E+01
15	7.740E 02	6 152E-02	-2.493E-02	2.799E-02	1.548E+01	1.230E+01	-4 985E+00	2 799E+00	1.264E+02
16	6 754E-02	-9.542E-02	-2 493E-02	2.816E 02	1.351E+01	-1 908E+01	-4 987E+00	2.816E+00	9.071E+01
17	-6.966E-03	1.572E-03	-1 506E-03	-8.249E 03	-1.393E+00	3 143E-01	-3.013E-01	-8 249E-01	9.742E+01
18	-1.203E 02	-1.545E-02	-4.296E-03	-4 589E 03	-2.405E+00	-3.090E+00	-8.592E-01	-4.589E-01	9.394E+01
19	-1.146E-02	1 389E-02	-5.536E-03	4.982E 03	-2.291E+00	2.778E+00	-1.107E+00	4.982E-01	9.891E+01
20	-1.319E-02	-3.000E-02	-5.233E-03	5.921E 03	-2.639E+00	-6.000E+00	-1.047E+00	5.721E-01	9.044E+01
21	-1.338E-02	3 525E-02	-4.637E-03	7 064E-03	-2.675E+00	7.049E+00	-9 274E-01	7 064E-01	1.033E+02
22	-1.495E-02	-5.662E-02	-3.720E-03	1.131E-02	-2.989E+00	-1.132E+01	-7.441E-01	1 131E+00	8 568E+01
23	-1.839E-02	7.282E-02	-3.152E-03	1.004E-02	-3.677E+00	1 456E+01	-6.304E-01	1.004E+00	1.103E+02
24	-1.595E-02	-9.642E-02	-4.642E-03	-2 737E-03	-3.190E+00	-1.928E+01	-9 284E-01	-2.737E-01	7.650E+01
25	7.461E-03	1.760E-03	-1.005E-03	-6.132E 03	1.492E+00	3.520E-01	-2 011E-01	-6.132E-01	1.024E+02
26	1.630E-02	-1 230E-02	-2.457E-03	-1.421E 03	3.261E+00	-2 460E+00	-4.915E-01	-1 421E-01	1.004E+02
27	1.767E-02	1.449E-02	-3.066E-03	1.385E 03	3.534E+00	2 898E+00	-6 133E-01	1.385E-01	1.060E+02
28	1.740E-02	-2.950E-02	-3.137E-03	4.407E-03	3.479E+00	-5 900E+00	-6 274E-01	4 407E-01	9.685E+01
29	1.653E-02	3.643E-02	-2.862E-03	5.972E-03	3.305E+00	7.286E+00	-5.724E-01	5.972E-01	1.103E+02
30	1.539E-02	-5 425E-02	-2 594E-03	5.809E-03	3.079E+00	-1.085E+01	-5.187E-01	5.809E-01	9.165E+01
31	1.503E 02	7.195E-02	-2 731E-03	3.454E-03	3.005E+00	1 439E+01	-5.463E-01	3.454E-01	1.170E+02
32	1.487E 02	-9.889E-02	-3.470E-03	3 498E 03	2.975E+00	-1 978E+01	-6 940E-01	3.498E-01	8.243E+01
33	-1 946E 03	2 702E-03	-1.692E-04	-1.486E 03	-3 893E-01	5.404E-01	-3.383E-02	-1.486E-01	1.002E+02
34	-4 042E-03	-1.171E-02	-5.488E-04	-1.130E 03	-8.084E-01	-2.342E+00	-1.098E-01	-1.130E-01	9.685E+01
35	-3.861E-03	1.567E-02	-8.507E-04	8 925E 04	-7.722E-01	3.134E+00	-1.701E-01	8.925E-02	1.022E+02
36	-3.824E-03	-2.863E-02	-9.320E-04	2 611E 03	-7.648E-01	-5.726E+00	-1 864E-01	2.611E-01	9.345E+01
37	-4 416E 03	3.703E-02	-8.802E-04	3.443E-03	-8.832E-01	7.406E+00	-1 760E-01	3 443E-01	1.062E+02
38	-4.910E-03	-5 417E-02	-8 523E 04	3 097E 03	-9.820E-01	-1 083E+01	-1.705E-01	3 097E-01	8.808E+01
39	-4.829E-03	7 160E-02	-9 916E-04	2 038E 03	-9.658E-01	1.432E+01	-1 983E-01	2 038E-01	1.129E+02
40	-3.080E-03	-9.821E-02	-1 388E-03	-1.032E 03	-6.159E-01	-1 964E+01	-2.777E-01	-1.032E-01	7 922E+01
41	1.881E 03	2.829E-03	-1 444E-04	-1 498E 03	3.761E-01	5.658E-01	-2 888E-02	-1.498E-01	1.011E+02
42	4.656E-03	-1.080E-02	-3.932E-04	-7 469E 04	9.313E-01	-2 160E+00	-7.863E-02	-7.469E-02	9.887E+01
43	5 499E-03	1.634E-02	-5.471E-04	4.881E 04	1.100E+00	3 269E+00	-1 094E-01	4 881E-02	1.044E+02
44	5 483E-03	-2 803E-02	-6.117E-04	1 336E 03	1.097E+00	-5.607E+00	-1.223E-01	1.336E-01	9 534E+01
45	5.398E-03	3.728E-02	-6 309E-04	1 758E-03	1.080E+00	7.457E+00	-1.262E-01	1 758E-01	1.084E+02
46	5.346E-03	-5.412E-02	-6.577E-04	1.696E 03	1.069E+00	-1.082E+01	-1 315E-01	1.696E-01	8.995E+01
47	5.479E-03	7.136E-02	-7.522E-04	1.010E 03	1.096E+00	1.427E+01	-1 504E-01	1.010E-01	1.151E+02
48	5.240E-03	-9.697E-02	-9.396E-04	1 288E 03	1.048E+00	-1 979E+01	-1 879E-01	1 288E-01	8.077E+01
49	-4.613E 04	3.061E-03	-1.301E 05	-2 819E-05	-9.226E-02	6.121E-01	-2.602E-03	-2 819E-03	1.007E+02
50	-1.050E 03	-1.052E-02	-5.525E-05	-3.808E-05	-2.100E-01	-2.104E+00	-1.105E-02	-3 808E-03	9 775E+01
51	-9 563E 04	1.684E-02	-1.136E-04	1.012E 04	-1 913E-01	3.367E+00	-2 271E-02	1 012E-02	1 032E+02
52	-7.575E-04	-2.776E-02	-1.541E-04	6.328E-04	-1.515E-01	-5.551E+00	-3 082E-02	6.328E-02	9.429E+01
53	-7.119E 04	3.747E-02	-1.734E-04	8 462E 04	-1 424E-01	7 495E+00	-3 468E-02	8 462E-02	1 072E+02
54	-7 113E 04	-5 417E-02	-2.001E-04	7 011E 04	-1 423E-01	-1 083E+01	-4.001E-02	7 011E-02	8.891E+01
55	-4 807E 04	7 125E-02	-2 521E-04	5 054E 04	-9.615E-02	1.425E+01	-5.041E-02	5 054E-02	1 138E+02
56	6 981E-04	-9 876E-02	-3 383E-04	-4 089E-04	1.396E-01	-1.975E+01	-6 765E-02	-4 089E-02	8 002E+01
57	3 152E-04	3 070E-03	-2.101E-05	-4 270E 04	6.304E-02	6 180E-01	-4.203E-03	-4 270E-02	1 008E+02
58	8.840E-04	-1.027E-02	-5.893E-05	-2 860E 04	1 768E-01	-2 054E+00	-1.179E-02	-2 860E-02	9.822E+01
59	1 216E-03	1.694E-02	-8 106E-05	1 046E 04	2 432E-01	3 387E+00	-1 622E-02	1 046E-02	1.037E+02
60	1.380E-03	-2 753E-02	-9 203E-05	1.217E 04	2 761E-01	-5 506E+00	-1 841E-02	1 217E-02	9 475E+01
61	1 483E 03	3 751E-02	-9.886E-05	2 921E 04	2 966E-01	7 503E+00	-1 977E-02	2 921E-02	1 077E+02
62	1 656E-03	-5 431E-02	-1 104E-04	6 055E 05	3 312E-01	-1.086E+01	-2 208E-02	6 055E-03	8 930E+01
63	1 879E-03	7 147E-02	-1 253E-04	2 418E 04	3 758E-01	1 429E+01	-2 505E-02	2 418E-02	1.145E+02
64	1 850E-03	-9 940E-02	-1 233E-04	6.335E 04	3 699E-01	-1 988E+01	-2 466E-02	6 335E-02	8 018E+01

NODE NO	DISPLACEMENTS U	V
1	2.083E-20	2.146E-20
2	1.374E-20	-2.461E-02
3	-1.033E-21	-1.979E-02
4	1.038E-21	-1.189E-02
5	-1.235E-21	-2.998E-02
6	1.413E-21	-1.373E-02
7	2.498E-21	-5.716E-02
8	1.082E-20	-3.864E-02
9	1.021E-20	-1.931E-01
10	-7.615E-20	1.726E-20
11	-8.965E-02	-9.859E-03
12	-8.436E-02	-2.247E-02
13	-8.430E-02	-7.103E-03
14	-8.502E-02	-3.450E-02
15	-8.228E-02	-5.075E-03
16	-8.307E-02	-6.495E-02
17	-6.911E-02	-1.547E-02
18	-7.323E-02	-1.146E-01
19	-1.509E-20	-1.240E-20
20	-5.663E-04	2.289E-03
21	-8.885E-03	-1.642E-02
22	-7.336E-03	-2.217E-03
23	-5.635E-03	-3.239E-02
24	-4.175E-03	2.271E-03
25	5.193E-04	-5.678E-02
26	2.107E-03	1.678E-02
27	-9.367E-03	-7.493E-02
28	1.769E-21	5.426E-22
29	-1.450E-02	8.548E-04
30	-1.901E-02	-1.134E-02
31	-2.013E-02	2.232E-03
32	-1.923E-02	-2.759E-02
33	-1.733E-02	8.244E-03
34	-1.622E-02	-4.594E-02
35	-1.793E-02	2.615E-02
36	-2.123E-02	-7.499E-02
37	-2.734E-20	-6.867E-21
38	4.239E 04	2.666E-03
39	-1.321E-03	-9.737E-03
40	-2.475E-03	5.674E-03
41	-2.090E-03	-2.350E-02
42	-1.416E-03	1.352E-02
43	-1.344E-03	-4.079E-02
44	-2.751E-03	3.101E-02
45	-6.665E-03	-6.564E-02
46	1.724E-20	-7.541E-21
47	-3.469E-03	2.738E-03
48	-5.512E-03	-8.282E-03
49	-6.005E-03	7.650E-03
50	-6.207E-03	-2.044E-02
51	-6.130E-03	1.660E-02
52	-6.450E-03	-3.742E-02
53	-7.303E-03	3.398E-02
54	-8.271E-03	-6.578E-02
55	-1.871E-20	-2.411E-21
56	2.922E 04	2.920E-03
57	3.941E-05	-7.661E-03
58	-5.593E-04	9.097E-03
59	-6.867E-04	-1.888E-02
60	-8.553E 04	1.865E-02
61	-1.034E-03	-3.558E-02
62	-1.762E-03	3.574E-02
63	-3.334E-03	-6.243E-02
64	8.963E-21	-9.617E-21
65	-6.304E-04	3.202E-03
66	-1.138E-03	-7.259E-03
67	-1.295E-03	9.653E-03
68	-1.466E-03	-1.788E-02
69	-1.500E-03	1.954E-02
70	-1.812E-03	-3.458E-02
71	-1.946E-03	3.661E-02
72	-1.754E-03	-6.273E-02
73	1.200E-20	-2.242E-22
74	-2.532E-20	2.978E-03
75	3.367E-20	-7.101E-03
76	-4.775E-20	9.861E-03
77	5.359E-20	-1.767E-02
78	-9.247E-20	1.995E-02
79	1.028E-19	-3.455E-02
80	-1.742E-19	3.720E-02
81	-5.396E-19	-6.225E-02

AT TIME 0.00035 NO ITERATION WAS REQUIRED

ELEMENT ELEMENT STRAINS AND STRESSES

NO	EPSILON-R	EPSILON-Z	EPS-THETA	GAMMA-RZ	SIGMA-R	SIGMA-Z	SIG-THETA	TAU-RZ	h
1	-6.682E-02	-2.311E-02	-2.864E-02	-3.014E-02	-1.336E+01	-4.681E+00	-5.727E+00	-3.014E+00	5.771E+01
2	-1.296E-01	3.634E-03	-5.553E-02	1.347E-02	-2.591E+01	7.767E-01	-1.111E+01	1.347E+00	6.055E+01
3	-1.251E-01	2.212E-03	-5.360E-02	2.402E-03	-2.501E+01	4.425E-01	-1.072E+01	2.402E-01	6.261E+01
4	-1.247E-01	-1.104E-02	-5.346E-02	7.550E-04	-2.495E+01	-2.208E+00	-1.069E+01	7.550E-02	6.071E+01
5	-1.215E-01	1.028E-02	-5.208E-02	6.821E-03	-2.430E+01	2.056E+00	-1.042E+01	6.821E-01	6.588E+01
6	-1.222E-01	-4.186E-02	-5.237E-02	-4.612E-03	-2.444E+01	-8.373E+00	-1.047E+01	-4.612E-01	5.751E+01
7	-1.173E-01	3.246E-02	-5.029E-02	1.734E-02	-2.347E+01	6.491E+00	-1.006E+01	1.734E+00	7.134E+01
8	-1.146E-01	-1.598E-01	-4.913E-02	7.558E-02	-2.293E+01	-3.195E+01	-9.825E+00	7.558E+00	4.975E+01
9	3.307E-02	-9.922E-03	-1.571E-02	-3.960E-02	6.613E+00	-1.984E+00	-3.141E+00	-3.960E+00	1.028E+02
10	6.092E-02	-5.017E-03	-3.152E-02	1.139E-02	1.218E+01	-1.003E+00	-6.304E+00	1.139E+00	1.033E+02
11	5.585E-02	-4.910E-04	-3.141E-02	6.310E-03	1.117E+01	-9.821E-02	-6.282E+00	6.310E-01	1.047E+02
12	5.710E-02	-1.048E-02	-3.086E-02	5.351E-03	1.142E+01	-2.097E+00	-6.172E+00	5.351E-01	1.032E+02
13	5.681E-02	1.322E-02	-2.967E-02	7.963E-03	1.136E+01	2.645E+00	-5.934E+00	7.963E-01	1.091E+02
14	6.034E-02	-4.694E-02	-2.877E-02	7.672E-03	1.207E+01	-9.388E+00	-5.754E+00	7.672E-01	9.712E+01
15	6.191E-02	6.114E-02	-2.630E-02	2.982E-02	1.238E+01	1.223E+01	-5.260E+00	2.982E+00	1.232E+02
16	5.570E-02	-1.287E-01	-2.728E-02	3.183E-02	1.114E+01	-2.573E+01	-5.456E+00	3.183E+00	8.209E+01
17	3.458E-03	-2.417E-03	-2.119E-03	-1.060E-02	6.916E-01	-4.834E-01	-4.238E-01	-1.060E+00	1.003E+02
18	6.292E-03	-5.411E-03	-5.469E-03	-3.245E-03	1.258E+00	-1.082E+00	-1.094E+00	-3.245E-01	9.904E+01
19	5.106E-03	-3.584E-03	-6.656E-03	5.671E-03	1.021E+00	-7.168E-01	-1.331E+00	5.671E-01	9.856E+01
20	4.018E-03	-8.816E-03	-6.294E-03	6.961E-03	8.037E-01	-1.763E+00	-1.259E+00	6.961E-01	9.801E+01
21	3.849E-03	1.306E-02	-5.672E-03	7.321E-03	7.698E-01	2.613E+00	-1.134E+00	7.321E-01	1.021E+02
22	2.481E-03	-4.070E-02	-4.698E-03	1.312E-02	4.962E-01	-8.140E+00	-9.396E-01	1.312E+00	9.234E+01
23	-3.219E-03	7.179E-02	-4.042E-03	1.153E-02	-6.438E-01	1.436E+01	-8.084E-01	1.153E+00	1.132E+02
24	-3.908E-03	-1.254E-01	-6.010E-03	-3.677E-03	-7.815E-01	-2.507E+01	-1.202E+00	-3.677E-01	7.260E+01
25	9.178E-04	-2.056E-03	-8.884E-04	-5.849E-03	1.836E-01	-4.113E-01	-1.777E-01	-5.849E-01	9.942E+01
26	4.627E-03	-1.785E-03	-2.346E-03	-2.549E-03	9.254E-01	-3.569E-01	-4.693E-01	-2.549E-01	1.004E+02
27	6.804E-03	-3.010E-03	-3.053E-03	2.132E-03	1.361E+00	-6.020E-01	-6.107E-01	2.132E-01	1.003E+02
28	5.832E-03	-8.328E-03	-3.089E-03	4.956E-03	1.166E+00	-1.666E+00	-6.177E-01	4.956E-01	9.875E+01
29	5.002E-03	1.409E-02	-2.787E-03	6.718E-03	1.000E+00	2.817E+00	-5.574E-01	6.718E-01	1.035E+02
30	3.443E-03	-3.722E-02	-2.509E-03	6.402E-03	6.886E-01	-7.443E+00	-5.019E-01	6.402E-01	9.275E+01
31	4.070E-03	6.978E-02	-2.766E-03	3.163E-03	8.140E-01	1.396E+01	-5.531E-01	3.163E-01	1.141E+02
32	7.797E-03	-1.273E-01	-3.737E-03	2.639E-03	1.559E+00	-2.545E+01	-7.474E-01	2.639E-01	7.541E+01
33	2.616E-03	-1.247E-03	-2.984E-04	-2.246E-03	5.231E-01	-2.494E-01	-5.968E-02	-2.246E-01	1.009E+02
34	4.647E-03	-7.987E-04	-7.946E-04	-6.143E-04	9.293E-01	-1.597E-01	-1.589E-01	-6.143E-02	1.007E+02
35	4.622E-03	-1.668E-03	-1.105E-03	8.253E-04	9.245E-01	-3.335E-01	-2.210E-01	8.253E-02	1.004E+02
36	4.924E-03	-7.508E-03	-1.207E-03	2.949E-03	9.847E-01	-1.502E+00	-2.414E-01	2.949E-01	9.937E+01
37	4.156E-03	1.497E-02	-1.150E-03	3.895E-03	8.312E-01	2.993E+00	-2.300E-01	3.895E-01	1.035E+02
38	3.859E-03	-3.751E-02	-1.140E-03	3.199E-03	7.717E-01	-7.501E+00	-2.281E-01	3.199E-01	9.302E+01
39	3.449E-03	6.972E-02	-1.316E-03	2.292E-03	6.897E-01	1.394E+01	-2.631E-01	2.292E-01	1.143E+02
40	2.795E-03	-1.269E-01	-1.730E-03	-2.248E-04	5.589E-01	-2.538E+01	-3.460E-01	-2.248E-02	7.440E+01
41	-8.580E-04	-8.584E-04	-8.435E-05	-9.789E-04	-1.716E-01	-1.717E-01	-1.687E-02	-9.789E-02	9.958E+01
42	-7.017E-04	-7.263E-05	-2.915E-04	-1.014E-03	-1.403E-01	-1.453E-02	-5.831E-02	-1.014E-01	1.000E+02
43	2.160E-04	-8.461E-04	-4.644E-04	6.594E-04	4.320E-02	-1.692E-01	-9.289E-02	6.594E-02	9.988E+01
44	9.131E-05	-6.845E-03	-5.318E-04	1.493E-03	1.826E-02	-1.369E+00	-1.064E-01	1.493E-01	9.852E+01
45	3.694E-05	1.524E-02	-5.597E-04	1.871E-03	7.388E-03	3.047E+00	-1.119E-01	1.871E-01	1.029E+02
46	-1.448E-04	-3.751E-02	-5.954E-04	1.927E-03	-2.896E-02	-7.502E+00	-1.191E-01	1.927E-01	9.222E+01
47	4.409E-04	6.938E-02	-7.228E-04	7.311E-04	8.818E-02	1.388E+01	-1.446E-01	7.311E-02	1.136E+02
48	1.975E-03	-1.275E-01	-9.817E-04	4.258E-04	3.951E-01	-2.551E+01	-1.963E-01	4.258E-02	7.445E+01
49	1.031E-03	-7.410E-04	-5.807E-05	-5.863E-04	2.062E-01	-1.482E-01	-1.161E-02	-5.863E-02	1.004E+02
50	2.004E-03	4.312E-04	-1.465E-04	7.097E-06	4.007E-01	8.624E-02	-2.930E-02	7.097E-04	1.005E+02
51	2.155E-03	-3.649E-04	-2.106E-04	7.528E-05	4.309E-01	-7.298E-02	-4.213E-02	7.528E-03	1.004E+02
52	2.408E-03	-6.489E-03	-2.577E-04	7.032E-04	4.816E-01	-1.298E+00	-5.155E-02	7.032E-02	9.913E+01
53	2.462E-03	1.536E-02	-2.814E-04	9.164E-04	4.925E-01	3.071E+00	-5.627E-02	9.164E-02	1.034E+02
54	2.544E-03	-3.747E-02	-3.193E-04	6.325E-04	5.088E-01	-7.495E+00	-6.385E-02	6.325E-02	9.280E+01
55	2.662E-03	6.918E-02	-3.729E-04	8.299E-04	5.325E-01	1.384E+01	-7.457E-02	8.299E-02	1.141E+02
56	3.073E-03	-1.273E-01	-4.423E-04	3.567E-04	6.146E-01	-2.546E+01	-8.846E-02	3.567E-02	7.467E+01
57	-1.381E-04	-6.734E-04	9.205E-06	3.706E-05	-2.761E-02	-1.347E-01	1.841E-03	3.706E-03	9.993E+01
58	-4.947E-05	7.110E-04	3.298E-06	-2.140E-04	-9.894E-03	1.422E-01	6.596E-04	-2.140E-02	1.003E+02
59	2.918E-04	-3.682E-04	-1.945E-05	6.307E-05	5.836E-02	-7.364E-02	-3.891E-03	6.307E-03	1.000E+02
60	4.715E-04	-6.037E-03	-3.143E-05	1.977E-04	9.430E-02	-1.207E+00	-6.286E-03	1.977E-02	9.888E+01
61	5.977E-04	1.512E-02	-3.984E-05	2.470E-04	1.195E-01	3.024E+00	-7.969E-03	2.470E-02	1.030E+02
62	8.032E-04	-3.733E-02	-5.354E-05	1.293E-04	1.606E-01	-7.466E+00	-1.071E-02	1.293E-02	9.254E+01
63	1.092E-03	6.921E-02	-7.282E-05	1.305E-04	2.185E-01	1.384E+01	-1.456E-02	1.305E-02	1.138E+02
64	1.338E-03	-1.279E-01	-8.923E-05	-2.172E-04	2.677E-01	-2.559E+01	-1.785E-02	-2.172E-02	7.436E+01

NODE NO	DISPLACEMENTS U	V
1	-1.712E-21	-5.402E-21
2	-3.420E-23	-2.938E-02
3	1.402E-21	-2.042E-02
4	-5.335E-22	-1.821E-02
5	5.961E-22	-2.843E-02
6	-3.683E-22	-2.140E-02
7	-3.809E-21	-5.577E-02
8	1.076E-20	-3.937E-02
9	1.242E-20	-2.234E-01
10	2.886E-20	1.833E-20
11	-8.018E-02	-1.744E-02
12	-7.529E-02	-1.913E-02
13	-7.480E-02	-1.691E-02
14	-7.489E-02	-2.877E-02
15	-7.094E-02	-1.524E-02
16	-7.571E-02	-6.460E-02
17	-6.510E-02	-1.609E-02
18	-7.245E-02	-1.516E-01
19	-6.852E-20	-3.621E-21
20	-1.405E-02	-2.407E-03
21	-1.958E-02	-1.075E-02
22	-1.880E-02	-1.375E-02
23	-1.669E-02	-2.306E-02
24	-1.552E-02	-1.014E-02
25	-1.045E-02	-5.467E-02
26	-6.544E-03	1.911E-02
27	-1.960E-02	-1.027E-01
28	6.100E-20	-7.456E-21
29	-7.137E-03	-2.426E-03
30	-1.392E-02	-4.909E-03
31	-1.426E-02	-8.875E-03
32	-1.319E-02	-1.740E-02
33	-1.132E-02	-4.193E-03
34	-9.690E-03	-4.107E-02
35	-1.374E-02	2.873E-02
36	-2.022E-02	-1.002E-01
37	-5.341E-20	5.904E-21
38	-5.301E-03	-1.686E-03
39	-6.497E-03	-2.772E-03
40	-8.072E-03	-4.827E-03
41	-7.716E-03	-1.296E-02
42	-6.790E-03	2.007E-03
43	-7.332E-03	-3.555E-02
44	-7.957E-03	3.421E-02
45	-1.041E-02	-9.143E-02
46	3.787E-20	-9.127E-21
47	-6.990E-05	-8.074E-04
48	-2.435E-03	-1.319E-03
49	-2.889E-03	-2.600E-03
50	-3.052E-03	-9.483E-03
51	-3.142E-03	5.485E-03
52	-3.262E-03	-3.197E-02
53	-5.129E-03	3.771E-02
54	-7.645E-03	-9.041E-02
55	-2.480E-20	5.584E-21
56	-1.786E-03	-9.095E-04
57	-2.123E-03	-5.434E-04
58	-2.770E-03	-9.547E-04
59	-2.988E-03	-7.761E-03
60	-3.132E-03	7.741E-03
61	-3.562E-03	-2.982E-02
62	-3.947E-03	3.927E-02
63	-4.876E-03	-8.768E-02
64	1.258E-20	-6.993E-21
65	2.761E-04	-5.724E-04
66	-1.772E-04	-7.615E-05
67	-4.064E-04	-3.947E-04
68	-5.365E-04	-6.557E-03
69	-6.588E-04	8.644E-03
70	-9.475E-04	-2.874E-02
71	-1.237E-03	4.052E-02
72	-1.440E-03	-8.709E-02
73	-3.131E-20	2.785E-21
74	5.676E-20	-7.744E-04
75	-5.070E-20	1.512E-04
76	3.384E-20	-2.667E-04
77	-8.342E-21	-6.169E-03
78	-4.420E-20	8.863E-03
79	1.150E-19	-2.841E-02
80	-2.520E-19	4.074E-02
81	-2.265E-19	-8.754E-02

FILM

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